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ABSTRACT

This curriculum guide provides technology learning activities designed to prepare students in grades 6-10 to work in the world of the future. The 8-day course provides exploratory, hands-on learning activities and information that can enhance the education of students of all types in an integrated curriculum that provides practical applications of academic skills. The guide contains both instructor and student sections. The instructor's section includes the following: background information; expected learner outcomes; suggested activities; suggested resources; instructional sequence; equipment, tools, and supplies worksheet; pretest and posttest with answers; and an evaluation summary. The student's section contains the following: an introduction; summary of activities; pretest and posttest instructions; assignments; goal; glossary; expected learner outcomes; objectives; related Technology Student Association events; academic and workplace applications; impact statements; career information; and an optional activity that could be used for solving problems or reinforcing learning. The guide contains activities for learning about research and design through designing and building a model race car. (KC)

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ED 380 599

Technology Learning Activity

Technology Education Series

RESEARCH AND DESIGN

TLA TE-1101

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CIMC

Teacher Edition

Oklahoma Department of Vocational and Technical Education
1500 West Seventh Avenue
Stillwater, OK 74074-4364

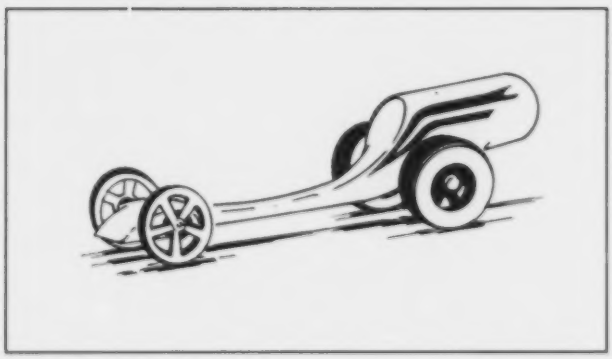
TECHNOLOGY EDUCATION

TECHNOLOGY LEARNING ACTIVITY

TE1101

RESEARCH AND DESIGN

Suggested Time: 8 Days



Developed by the
Curriculum and Instructional Materials Center
for the Technology Education Division
Oklahoma Department of Vocational and Technical Education

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Curriculum and Instructional Materials Center

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TABLE OF CONTENTS

FOREWORD 4
PREFACE 5
ACKNOWLEDGEMENTS 6

TECHNOLOGY EDUCATION OVERVIEW
- About the Program 8
- About the TLAs 10
- About Ordering TLAs 12
- Corrections and Suggestions 14

USING THIS PUBLICATION: INSTRUCTOR'S SECTION
- Background Information 15
- Expected Learner Outcomes 15
- Suggested Activities 17
- Suggested Resources 18
- Instructional Sequence 18
- Equipment, Tools, and Supplies Summary Worksheet 18
- Pretest and Posttest 19
- Test Answers 19
- Evaluation Summary 19

USING THIS PUBLICATION: STUDENT'S SECTION
- Introduction 20
- Summary of Activities for the Day 20
- Pretest Instructions 21
- Assignments to Turn In 21
- Goal 21
- Words You Should Know 21
- Expected Learner Outcomes 22
- Objectives 22
- Related TSA Competitive Events 22
- Academic and Workplace Applications 23
- Impact Statements 29
- Career Search 30
- Posttest Instructions 30
- Skunk Works 31

HAZARD ALERT MESSAGES 32

INSTRUCTOR'S SECTION 35

STUDENT'S SECTION

FOREWORD

What will be the careers of the future? The workforce of tomorrow will be shaped by the technologies being developed today. Students today need accurate, interesting information on growing technologies in order to make informed decisions about their futures.

It is our hope that this curriculum will help improve the quality of career decisions for our students. Students are introduced to a wide range of current, "cutting-edge" technologies and are encouraged to think critically about how those technologies influence their lives and futures. Today's students do not have to become the victims of "technological illiteracy," but instead can learn to anticipate technological developments and take positive steps to prepare for the future.

Technology Learning Activities provide students with the knowledge and an introduction to the skills they need for a positive learning and career experience. Every generation is faced with learning how to manage technological advances. Information gained through participation in the *Technology Education* program can help students develop a holistic view of technology on which to base their educational and career decisions.

Roy Peters, Jr., Ed.D., State Director
Oklahoma Department of
Vocational and Technical Education

Roger Stacy, Ed.D., State Supervisor
Technology Education
Oklahoma Department of
Vocational and Technical Education

PREFACE

We believe that one of the most effective ways to improve education is through the development and implementation of a sound instructional materials system. Technology Education instructional materials represent a new design for CIMC which recognizes the importance of graphic materials in the learning process.

Technology Education instructional materials are designed for 6th through 10th grade students. The design of these materials is based on current research on how people read and gain information from documents. The design is called "New Look" and integrates both graphics and text into a balanced presentation which is easy to use and follow.

Technology Education provides the student a look at what the world will be like in the future based on technologies in use and being developed today. Throughout the Technology Education instructional materials, the students are introduced to "cutting-edge" technologies that they will use and encounter in a working environment later in life. This exposure gives them a wide range of experiences on which to base career decisions.

This publication is intended as a starting point, from which the teacher can innovate, localize, and personalize in order to prepare students for their future. The *Technology Education* series of Technology Learning Activities was written with the realization that we are creating the workforce of tomorrow by how and what we teach about technology today.

Sherry Wietelman, Curriculum Development Specialist
Curriculum and Instructional Materials Center
Oklahoma Department of
Vocational and Technical Education

Charles F. Kemnitz, President
Atlatl Communications, Inc.

ACKNOWLEDGEMENTS

The Curriculum and Instructional Materials Center (CIMC) extends its appreciation to those individuals who played important roles in the development of Technology Learning Activity materials.

Generous thanks is extended to Lynn Hawkins and Jim Harder, both Technology Education teachers at Mayfield Junior High School, for the time, talent and knowledge they contributed in determining the content of this Technology Learning Activity (TLA). We also extend our thanks to them for writing the pilot TLA upon which this TLA was based.

Thank you is also extended to the vocational educators who helped with field testing and contributed their expert input on individualized vocational instructional methods.

Alan Fillmore
Meeker High School

Jerry Lewis
Atoka High School

Ron Givens
Tulsa-Nimitz Middle School

We also thank the State Director, Dr. Roy Peters, Jr., and the Assistant State Director, Dr. Charles O. Hopkins, for their continued support throughout this project.

The school administrators who supported instructor participation in this project and/or allowed their facilities to be used as field test sites in this project deserve a special thank you, as well.

Chris Gillespie
Atoka High School

Brent Walden
Meeker High School

Marolyn Hunnicutt
Tulsa-Nimitz Middle School

Joe Shirley
Mayfield Junior High School

Oklahoma Department of Vocational and Technical Education Technology Education staff who provided leadership and direction on this project also deserve special recognition.

Roger Stacy, Ed.D.
State Supervisor
Technology Education

Donovan Bowers
Assistant State Supervisor
Technology Education

Harold Holley
Assistant State Supervisor
Technology Education

Special Recognition and gratitude is expressed to Dr. Charles F. Kemnitz who trained and coordinated the efforts of a team of technical writers on this project. His professionalism, dedication and commitment to quality instructional materials allowed us to design learning activities that students can readily use to explore new and existing technologies.

Only through the close cooperation of the Curriculum and Instructional Materials Center staff was this curriculum developed. Sincere thanks are shared with the CIMC coordinators.

Brenda Stacy, Ed.D.
CIMC Coordinator

Lynna Ausburn, Ph.D.
CIMC Development Coordinator

Special recognition and thanks are also extended to other individuals within the Oklahoma Department of Vocational and Technical Education (ODVTE) involved in the development and distribution process: Noel Wilcoxson, Duane "Frosty" Foster and Diane Ensign and their staffs at the ODVTE Print Shop; Bob Davis and staff artist Kathryn Moore for the cover design; Darrel Stiles and his staff in the ODVTE Warehouse for packaging and coordinating transportation and distribution of these materials; and Rose Primeaux and her staff in Word Processing.

Finally, a big thank you to all ODVTE team members who offer their support on a daily basis in "behind-the-scenes" ways but never seem to be recognized for their contributions: Suzanne Perry and Terri Tomson, CIMC secretaries; Karen Heppel and Shirley Hill, Technology Education secretaries.

Sherry Wietelman
Curriculum Development Specialist
Curriculum and Instructional Materials Center
Oklahoma Department of Vocational and Technical Education

TECHNOLOGY EDUCATION OVERVIEW

About the Program

Because the American culture is distinctly characterized as technological, it becomes the function of our schools to give every student an insight into and an understanding of the technological nature of the culture. Technology Education strives to perform this function.

Technology Education in Oklahoma is an instructional program that provides young men and women (grades 6 - 10) with daily, hands-on exploratory experiences and insights into technology and career opportunities so that they can make meaningful occupational and educational choices. It is a program which can enhance the educational experience of all students, whether they are the valedictorian/honor-type student, the middle range/average student, or the student who has found little success in school, namely the at-risk student.

Technology Education acquaints all students with their technological environment so they can make rational decisions about their own lives on a day-to-day basis and participate in controlling their own destiny. The program directs students to related technological and industrial fields, enabling students to realize their full potential and make maximum use of their individual talents in fulfilling career goals in their selected areas of employment.

Technology education capitalizes on the individual's potential for reasoning and problem solving, for imagining and creating, and for constructing and expressing through the use of tools and materials related to technology. It develops content and

TECHNOLOGY EDUCATION OVERVIEW

experiences to contribute to the growth and development of students commensurate with their potential. Thus, Technology Education is a basic and fundamental study for all persons in regard to career explorations and educational opportunities.

Opportunities to develop and apply leadership, social, civic, and technologically related skills are provided through the Technology Student Association (TSA). TSA is the appropriate vocational student organization identified as a teaching tool for teachers to use in assisting students to achieve identified course competencies. Competency-based activities are an integral part of the instructional program.

All Technology Education courses are taught in a one-period block of time (45-55 minutes), with each of the four Technology systems (communication, construction, manufacturing, and transportation, energy and power) being designed to provide a means through which other courses such as math, science, English, and social studies can be applied in a practical manner within a technology-based situation. Teaching across the curriculum is vital to the success of a Technology Education program.

TECHNOLOGY EDUCATION OVERVIEW

About the TLAs

The *Technology Education* series consists of 40 Technology Learning Activities (TLAs) for instruction and a supplemental activities book. Each TLA is divided into two parts: an instructor's guide and a student guide. The instructor's guide provides an overview of Technology Education, a summary of activities and supplies needed for students to complete the Technology Learning Activity, a supplies and materials worksheet for the instructor, an overview of the particular TLA, written exam answer sheets, and evaluation summary for the TLA.

Master copies of the evaluation summary sheets, pretest and posttest, and supplies and materials worksheets are provided with this instructors edition of the TLA. These sheets may be reproduced for classroom use.

All of the TLAs focus on measurable and observable learning outcomes. Instructors are encouraged to supplement, personalize, localize, and motivate with these materials in order to develop a complete teaching/learning process.

TLAs are designed for use in more than one class period of instruction. Careful study of each TLA by the instructor will help her or him determine the following:

- Skills to demonstrate
- Supplies and equipment needed

TECHNOLOGY EDUCATION OVERVIEW

- Amount of time needed for student practice
- Workstation Bookshelf, Instructors Reference Materials, and a bibliography are provided for supplemental resources
- Supplementary materials, including print and non-print media to order
- Resource people to contact
- Facility modifications which may be necessary to administer the TLA

Each TLA is based on performance objectives. Performance objectives are specific, stating the performances necessary to meet the goal of the TLA.

The overall goal of the unit tells what the student should be able to do and what standard will be used to determine whether the student has achieved competency. The specific objectives outline the sequence of the competencies required to meet the TLA goal. The competencies may be either cognitive, requiring knowledge only, or psychomotor, requiring knowledge and skill.

TECHNOLOGY EDUCATION OVERVIEW

About Ordering TLAs

Additional TLAs in the *Technology Education* series may be ordered through the Oklahoma Department of Vocational and Technical Education, Curriculum and Instructional Materials Center, 1500 West Seventh Avenue, Stillwater, OK 74074-4364. Phone 1-800-522-5810.

NOTE: The 1100- and 1200-series numbers given on the next page are for ordering TLA Instructor's Editions; to order Student Editions, change the first two numbers to 31 (for 8-Day TLAs) or 32 (for 6-Week TLAs).

TECHNOLOGY EDUCATION OVERVIEW

TLA Title	Order No.
8-DAY TLAs	
Aerospace and Flight	TE1117
Agricultural Education	TE1123
Audiovisual Programming	TE1131
CAD — Autocad Release 10	TE1114
Career Search	TE1104
Drafting	TE1134
Electricity — Principles and Applications	TE1105
Electronic Publishing	TE1135
Electronics (CES)	TE1106
Fluidics Technology	TE1116
Health Occupations	TE1124
Home Economics	TE1125
Introduction to VoTech	TE1122
Introduction to Animation	TE1132
Keyboarding and Computer Application	TE1115
Laboratory Safety for Construction Technology	TE1107
Laser/Fiber Optics/Holography	TE1129
Lasers Technology	TE1103
Marketing Education	TE1126
Material Processes — Plastics	TE1133
NASA Aerospace-Spacelink	TE1111
Photography	TE1130
Problem Solving	TE1110
Research and Design	TE1101
Residential Construction	TE1121
Robotics — Control Technology	TE1112
Robotics — ProArm	TE1113
Structural Engineering	TE1102
Synergetic Technology	TE1120
Technical Report Writing	TE1118
Technology Challenge	TE1109
Thermal Screen Printing	TE1119
Trade and Industrial Education	TE1127
TSA Leadership	TE1108
Vocational Business	TE1128
6-WEEK TLAs	
Animator	TE1203
CAD/Board Drafting	TE1201
Control Technology	TE1202
Electronics/Electricity/Robotics	TE1204
Electronic Publisher	TE1205

Corrections and Suggestions

CIMC wants to provide Technology Education instructors and students materials that are accurate and effective. Although the CIMC strives to maintain the highest standards of development and production, oversights occasionally do occur. If you find any errors in this or other CIMC publications or have suggestions for improving their usefulness, please notify the CIMC staff. One easy way of pointing out errors is to make a photocopy of the affected page and indicate the correction on the copy. Mail this information to the CIMC, where it will be used to correct the publication before the materials are reprinted.

To ensure that the material is updated on a timely basis, notify the CIMC of necessary corrections as soon as possible. Do not assume that someone else will notice the error and inform the CIMC; other users may be making the same assumption. Please send corrections and recommendations for improving this publication to the following address:

Curriculum Development Coordinator
Curriculum and Instructional Materials Center
Oklahoma Department of Vocational and Technical Education
1500 West Seventh Avenue
Stillwater, Oklahoma 74074-4364

USING THIS PUBLICATION

INSTRUCTOR'S SECTION

Background Information

The background information component provides instructors with basic information about the subject of the TLA. Instructors are encouraged to use suggested resources for additional information on the specific technology used in each TLA.

Expected Learner Outcomes

There are 19 Expected Learner Outcomes for the *Technology Education* series. Not every TLA fulfills all 19 Expected Learner Outcomes, so outcomes specific to each TLA are listed in the Instructors Section and in the Students Section. The 19 Expected Learner Outcomes for the *Technology Education* series are:

- The student will know and appreciate the importance of technology and technological literacy.
- The student will explore career opportunities so they can make meaningful occupational choices.
- The student will explore future educational opportunities so they can make meaningful educational choices.
- The student will apply problem solving and critical thinking techniques.
- The student will apply math, science, reading, and other school subjects in a practical situation.
- The student will develop keyboarding and computer literacy skills.

USING THIS PUBLICATION

INSTRUCTOR'S SECTION

- The student will develop basic skills in the safe and proper use of tools, machines, materials, processes, and technical concepts.
- The student will recognize and develop individual talents.
- The student will think logically and sequentially.
- The student will develop leadership, creative abilities, positive self-concepts, and individual potential in a technological society.
- The student will become a more sophisticated consumer of the goods and services of a technological society.
- The student will adjust to a changing technological environment.
- The student will develop an understanding and the ability to adapt to those technological forces that influence life in the 21st Century.
- The student will develop an understanding of economic development.
- The student will communicate by making clear and relevant points through the development of mental process skills.

USING THIS PUBLICATION

INSTRUCTOR'S SECTION

- The student will apply design, imagination, and creative abilities.
- The student will learn applications of lifelong learning skills.
- The student will think globally and act locally.
- The student will explore the organization and management systems of business and industry.

Suggested Activities

The suggested activities component is to assist during the preparation stage of the teaching/learning process. The activities provide suggestions for preparation and evaluation during the instructional process. The instructor should read the suggested activities before assigning the TLAs to allow time to obtain supplemental materials, prepare audiovisual materials, and contact outside resource persons. Duties of the instructor will vary according to the particular TLA.

USING THIS PUBLICATION	INSTRUCTOR'S SECTION
Suggested Resources	Suggested resources include people, and print and non-print media that may be used with the TLA. References used during the development of each TLA are also provided. The instructor can use suggested resources and TLA references to supplement her or his knowledge of the subject to help students with particular interests or objectives in the area covered. Please note that suggested resources and references listed in this publication existed when this publication was written. CIMC assumes no responsibility for providing these materials and cannot ensure the availability of these materials as individual vendors, manufacturers, and publishers may discontinue these products at any time.
Instructional Sequence	This component provides instructors with daily lesson plans for the TLA. Included in the instructional sequence component are suggested daily assignments and equipment, tools, and supplies that will be needed for each student. A column for facility requirements or modifications is provided for each instructor. This component is provided as a guide to plan for and monitor students' progress through the TLA.
Equipment, Tools, and Supplies: Summary Worksheet	This component is provided as a planning tool for instructors. It provides instructors with a list of the necessary equipment, tools and supplies to support student activities and provides specific information for budgeting purposes.

USING THIS PUBLICATION	INSTRUCTOR'S SECTION
Pretest and Posttest	These components provide criterion-referenced evaluation of the objectives listed in each TLA. If objectives or activities have been added, deleted, or modified, appropriate changes should be made on the tests.
Test Answers	This component is provided to assist instructors in evaluating student performance on written tests.
Evaluation Summary	This component is provided to assist instructors in summarizing the performance of each student on an individual basis. The evaluation summary forms are also provided as photocopy masters for the instructors use.

USING THIS PUBLICATION

STUDENT'S SECTION

Introduction

Daily activities are the step-by-step procedures students will follow to complete the learning experience. Each TLA is organized by daily tasks and activities. Students are able to pace their progress through the TLA by referring to the activities for the day.

Within the daily activity pages are components common to all TLAs.

Summary of Activities

A Summary of Activities page begins each day of the TLA. This page provides several important pieces of information for both the student and instructor.

❶ In the left column this page provides the student with a list of activities to be accomplished that day.

❷ In the right column the major Academic and Workplace Application which applies to that day's activities is graphically indicated with a standard icon.

❸ Below the icon is a list of specific skills reinforced during that day's activities.

USING THIS PUBLICATION	STUDENT'S SECTION
Pretest Instructions	The students are required to take a Pretest as one of the first day's activities. The instructions for the Pretest are given in this section.
Assignments to Turn In	Day One includes a list of all assignments the students are expected to turn in during or at completion of the TLA. This list includes all tests, activities, and products covered in the TLA.
Goal	On Day One, following the assignments checklist, is a concise statement of the overall goal of the TLA. This statement summarizes the purpose for completing the TLA and encourages the student to think about the broader implications of the learning experience.
Words You Should Know	The first day's activities includes a glossary of unfamiliar technical terms used in the TLA. Often these terms are necessary for the student in order to accurately follow instructions in the activity procedures. The students should be encouraged to review this glossary and refer to it often during the course of the TLA.

USING THIS PUBLICATION	STUDENT'S SECTION
Expected Learner Outcomes Reinforced by this TLA	As stated in the guide to the Instructor's Section, there are 19 identified Expected Learner Outcomes associated with the *Technology Education* series. This section of Day One activities lists the Expected Learner Outcomes that specifically apply to the TLA. A student who reviews this list will gain a better understanding of the scope of experiences and skills to be gained from the TLA.
Objectives	Each TLA is made up of a set of measurable objectives. In this section on Day One, students are given a list of all the objectives addressed in the TLA. This list can serve to introduce students to the "flow" of the TLA as they build introductory skills in a technology.
Related TSA Competitive Event(s)	Each TLA may be used by students to begin work toward completion of a Technology Student Association competitive event. Some TLAs are tied to a specific TSA event; other TLAs may be used with several events. This Day One section gives the student and instructor a list of appropriate TSA events which the TLA may support. TSA competitive events promote leadership development, and an understanding that winning isn't everything but involvement is. Events are staged at Local, Regional, State, and National levels through which the student may progress.

USING THIS PUBLICATION

STUDENT'S SECTION

Academic and Workplace Applications

The curricular content and activities found in this Technology Learning Activity help students apply academic and workplace competencies. These competencies include: Reading Skills, Writing Skills, Mathematics Skills, Science Skills, Oral Communications Skills, Interpersonal or Relating Skills, Creative Thinking and Problem Solving Skills, Employability Skills, and Social Studies Skills.

Preparing students to enter successfully into today's world ...

Preparing students to enter successfully into today's world of work offers vocational education a substantial challenge. The contemporary workplace is characterized by constant and rapid technological change and by increasing job complexity and skill intensity. Due to rapid technological advancement, the half-life of work skills is now reduced to a bare three to five years. Out of this new workplace environment has arisen a growing national awareness of the critical importance of an American workforce armed with the skills necessary to survive in a competitive economy.

... emergence of a renewed emphasis on basic academic skills ...

One result of this national awareness has been the emergence of a renewed emphasis on basic academic skills in all areas of education. Pressure to increase academic skill development is being placed on education by both legislative action and industry mandate. The Carl D. Perkins Vocational and Applied Technology Education Act of 1990 sets stringent academic and workplace skill requirements for vocational education. State legislatures are increasingly requiring basic skills accountability by teachers and school administrators.

USING THIS PUBLICATION	STUDENT'S SECTION
... expected learner outcomes are being implemented with increasing frequency.	Graduation exams, minimum competency requirements, and expected learner outcomes are being implemented with increasing frequency. In addition, business and industry are delivering the message clearly to educators that vocational competence now requires increased strength in academic and workplace skills.
The issue of basic skills ... was successfully addressed in a national three-year study ...	The issue of the basic skills currently required in the work place was very successfully addressed in a national three-year study conducted jointly by the American Society of Training and Development (ASTD) and the U.S. Department of Labor (DOL). The findings of this study were published in 1990 in the book, *Workplace Basics: The Essential Skills Employers Want.*
... research indicates clearly that American employers ... need a variety of skills ...	The ASTD/DOL research indicates clearly that American employers have discovered that their workforces need a variety of skills that include, but are not limited to, the classic academic trio of reading, writing, and computation. Employers now are also looking for competence in areas such as "learning to learn," problem solving and critical thinking, interpersonal and teamwork skills, oral communication and listening techniques, and the social and personal management skills that demonstrate a capacity for independence and responsibility in on-the-job performance.

USING THIS PUBLICATION

STUDENT'S SECTION

... business and industry have expanded and re-defined "workplace basics."

It is clear that the requirements of today's business and industry have expanded and re-defined "workplace basics." It is in line with this re-definition, and with the competency requirements of current education legislation, that the Oklahoma Department of Vocational and Technical Education has chosen to address "basic skills" in the instructional materials produced by its Curriculum and Instructional Materials Center.

CIMC materials contain information and activities which develop academic and workplace application competencies ...

It is not a new development for CIMC materials to contain information and activities which develop academic and workplace application competencies in students undertaking vocational programs. What is new is the specific marking, or flagging, of items in our instructional materials that address academic and workplace application skills.

To assist teachers and students in identifying activities which promote academic and workplace skills ...

To assist teachers and students in identifying activities which promote academic and workplace skills development, CIMC has implemented a marking system which uses simple graphic symbols, or icons. These icons are located in the right margins of Activity Sheets. The following is an explanation of the icons and the kinds of academic and workplace application activities they indicate.

USING THIS PUBLICATION

READING SKILLS: Skills involving use of print resource material for obtaining and applying information.

WRITING SKILLS: Skills involving written communication of processes, information, or ideas.

MATHEMATICS SKILLS: Skills involving computation, calculation, and interpretation of numerical data.

STUDENT'S SECTION

Current vocational education literature indicates that functional literacy as a workplace basic needs to be defined in terms of reading competencies actually required for job performance. The activities identified with this icon as addressing reading skills in CIMC materials deal specifically with developing reading skills in an applied, job-related context. These range from general information-gathering activities to tasks requiring use of specific technical reference materials. Many contain a "learning to learn" aspect, which promotes engaging actively and purposefully in vocationally relevant enquiry.

Tasks identified with this icon promote development of skills in written communications. As with reading skills, the writing skills emphasized in CIMC materials have a vocational context. They include filling out forms, keeping work activity records, writing simple memos and letters, generating more complex reports and articles, and written expression of ideas and concepts related to vocational performance or exploration.

This icon identifies activities which develop vocationally-related skills in computation, measurement and estimation, selection and application of appropriate mathematical processes, and collecting, displaying, or interpreting data.

USING THIS PUBLICATION

SCIENCE SKILLS: Skills involving mastery and application of scientific information or theory.

ORAL COMMUN -ICATION SKILLS: Skills involving speaking and listening.

INTER-PERSONAL OR RELATING SKILLS: Skills involving working and getting along with others.

STUDENT'S SECTION

This icon marks activities which are related to the development of skills in either the physical or biological sciences. These skills stress occupationally-related applications of science and technology.

Activities marked with this icon promote development of effective speaking and listening. They include practice in such areas as speaking techniques, word choice, non-verbal messages, use of communication media, and using active listening techniques. Many of these activities promote "learning to learn" skills in verbal enquiry.

Activities which deal directly with skills in relating to others are marked with this icon. This includes areas such as multi-cultural awareness, group processes and dynamics, negotiation, dealing with conflict, cooperation and teamwork, values and attitudes, and leadership and motivation.

USING THIS PUBLICATION

CREATIVE THINKING AND PROBLEM SOLVING SKILLS: Skills involving comprehending, applying, analyzing, and developing complex ideas and situations.

EMPLOY-ABILITY SKILLS: Skills involving choosing, obtaining, and succeeding in a career.

SOCIAL STUDIES SKILLS: Skills involving investi-gation and application of social concepts.

STUDENT'S SECTION

This icon identifies activities which stress development of higher-order thought processes such as problem identification and analysis, lateral thinking, evaluating alternatives, developing solutions, examining assumptions, and evaluating outcomes.

Activities marked with this icon relate to competencies required to obtain employment and develop a career. These competencies include specific occupational tasks. They also include items such as career analysis and selection, job searching, completing applications and resumes, interviewing, and business etiquette and personal management skills required for job-keeping and maturing in one's work. Examples of the latter category include personal presentation, self-discipline, work accuracy, reliability, discretion, punctuality, stress handling, judgement, confidence, etc.

This icon marks activities which stress competencies in fields relating to human society and its distribution and relationships. This includes areas such as history, geography, government and politics, economics, psychology, sociology, demographics, current events, cross-cultural studies, consumer issues, environmental issues, and ethical concerns in science and technology.

USING THIS PUBLICATION

Impact Statements

STUDENT'S SECTION

There are five areas of human culture for which each TLA has an impact. These impact statements appear during Day Eight, after the student has gained some familiarity with the technology.

1. *ENVIRONMENTAL IMPACT:* A statement introducing the student to the impact of the technology on the environment.

2. *SOCIAL/CULTURAL IMPACT:* A statement concerning the impact of the technology on society and culture.

3. *ECONOMIC IMPACT:* A statement concerning the impact of the technology on the economy.

4. *POLITICAL IMPACT:* A statement concerning the impact of the technology on politics, laws, and regulations, and the impact of politics on the development of the technology.

5. *ERGONOMIC IMPACT:* A statement concerning the ergonomic implications of the technology. Ergonomics is the study of developing products and systems that meet peoples' needs.

USING THIS PUBLICATION

STUDENT'S SECTION

Impact Statements offer the student the opportunity to see beyond the activities in the Technology Learning Lab and glimpse the real-world applications of the technology.

Career Search

Also on Day Eight, the students are given the assignment of investigating several career opportunities related to the technology of the TLA. The investigation is done with *Career Search Abstracts*. A list of up to five careers related to the TLA is given, followed by pages from *Career Search Abstracts* that detail the career qualifications and work environment. The student is required to choose two of the five related careers, read the appropriate abstracts, then write a short essay about why those careers may be appealing.

Posttest Instructions

The students are required to take a Posttest as one of the last day's activities. The instructions for the Posttest are given in this section. The score for the Posttest may be compared to the score for the Pretest to help determine the student's gain during the TLA.

USING THIS PUBLICATION

Skunk Works

STUDENT'S SECTION

Skunk Works, a Day Eight optional activity, includes instructions that could be used for solving problems or reinforcing the enrichment of learning.

The term Skunk Works was coined by engineers at 3M Corporation in the mid-1960s. Some engineers wanted to develop a new product, but company management would not give them the time or money to work on the project. So the engineers "borrowed" time and money from approved projects to work on their "Skunk Works." When they finished developing the product, they presented it to management and it has been a 3M product ever since. The product: Velcro fasteners.

USING THIS PUBLICATION

HAZARD ALERT MESSAGES

The Daily Activities include hazard alert information specific to the Activity. These messages should be discussed carefully and thoroughly. The Hazard Alert Message system used in the TLA is based on the American National Standards Institute (ANSI) Standard Z535, which provides for five levels of alert.

Students are introduced to the ANSI Hazard Alert Message system as an activity in the Laboratory Safety for Construction Technology TLA (TE1107/TE3107). This system was adopted by ANSI as the standard in 1990 and will be the hazard alert system in use when students reach the workplace.

Hazard Alert Messages in the TLA are indicated both by the color red and graphically. There are three types of hazard alert graphics used in the TLA: the hazard alert symbol, injury hazard graphics, and avoidance graphics.

Hazard Alert Symbol

This Hazard Alert Symbol is used with the words DANGER, WARNING, and CAUTION. ANSI defines these words as:

DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

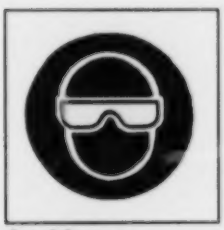
WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION indicates a hazardous situation which, if not avoided, may result in minor or moderate injury.

HAZARD ALERT MESSAGES

Injury Hazard Graphic

There are two types of graphics used in conjunction with the hazard alert symbol. This type of graphic depicts a specific injury that may be expected if the hazard described in the alert is not avoided.



Avoidance Graphic

This second type of graphic is called an avoidance graphic. It depicts an action the student should take in order to avoid injury.

There are two other ANSI words used in the TLAs and the students should understand their meanings:

NOTICE indicates an action that could result in damage to property or equipment.

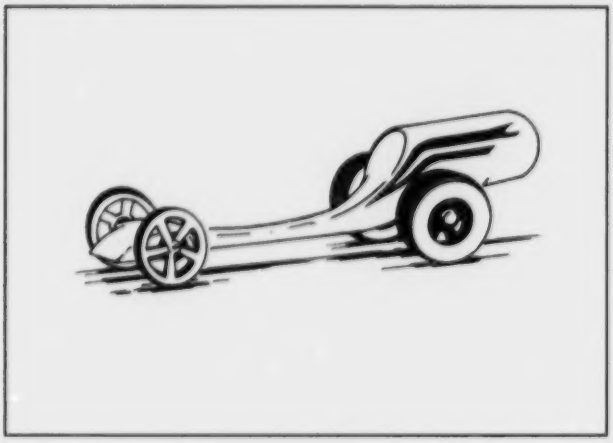
IMPORTANT indicates an instruction that can help the student do a better job.

TECHNOLOGY EDUCATION

RESEARCH AND DESIGN

TE1101/TE3101

INSTRUCTOR'S SECTION



BACKGROUND INFORMATION

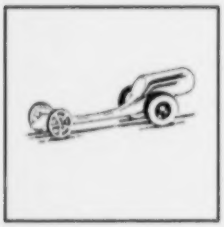
New developments in transportation technology are making today's vehicles more efficient, more economical, and safer than vehicles in the past. The design of the vehicle greatly influences these factors.

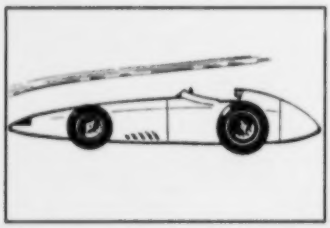
Principles of aerodynamics are used in designing automobiles and should be considered when students design their Metric 500 dragsters. Aerodynamics is a science that deals with the interaction of air and moving objects.

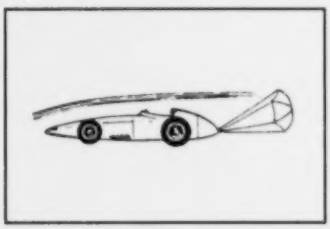
Air tends to resist or slow movement. Vehicles meet this resistance as they are moved through air. The faster they travel, the greater the resistance. A strong, power-robbing force is created. It is called "aerodynamic drag."

— Continued —

INSTRUCTOR'S SECTION



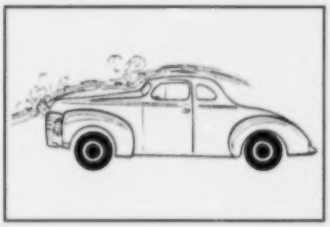




BACKGROUND INFORMATION

The amount of pressure drag and friction drag depends on the shape of the body. The product of the aerodynamic drag coefficient and the frontal area of the object is commonly referred to as the "drag form factor" of the object.

INSTRUCTOR'S SECTION



EXPECTED LEARNER OUTCOMES

- The student will know and appreciate the importance of technology and technological literacy.
- The student will explore career opportunities so they can make meaningful occupational choices.
- The student will explore future educational opportunities so they can make meaningful educational choices.
- The student will apply problem-solving and critical thinking techniques.
- The student will apply math, science, reading, and other school subjects in a practical situation.
- The student will develop basic skills in the safe and proper use of tools, machines, materials, processes, and technical concepts.
- The student will recognize and develop individual talents.

INSTRUCTOR'S SECTION

SUGGESTED ACTIVITIES

✓ Obtain materials to supplement TLA.

See Suggested Resources for computer software and books to supplement this module.

✓ Review instructional outline for this TLA. Modify time frames to suit class needs and plan activities for each class period.

✓ Study the specific objectives to determine those you will cover in your presentation. Decide also which objectives should be taught to which students.

✓ Determine scope and sequence of objectives that you add to the TLA. Design and develop support materials, including evaluation techniques, for additional objectives.

✓ Determine how you will schedule time for students to demonstrate competence in the required procedures.

✓ Make arrangements for guest speakers. Supply speakers with specific objectives and other appropriate sections of this TLA.

✓ Find a design concepts book showing different aerodynamic vehicle designs.

INSTRUCTOR'S SECTION

PREPARATION

SUGGESTED RESOURCES

CAR BUILDER

This software allows a student to design a car using computer aided design (CAD), then test the design in a "windtunnel" and "on the road." It is available from Selective Software, Express Distribution Center, 2515 East 43rd Street, Chattanooga, TN 37422-7217, and can be ordered by calling 1-800-423-3556.

Fales, James F. *Technology: Today and Tomorrow*, Glencoe Publishing Company: Mission Hills, CA, 1988.

Hacher, Michael and Robert Borden, *Living with Technology*, Delmar Publishers, Inc.: Albany, NY, 1988.

INSTRUCTOR'S SECTION

COMPUTER SOFTWARE

WORKSTATION BOOKSHELF

INSTRUCTOR'S REFERENCE MATERIALS

Fales, James F. *Technology: Today and Tomorrow*, Glencoe Publishing Company: Mission Hills, CA, 1988.

Hacher, Michael and Robert Borden, *Living with Technology*, Delmar Publishers, Inc.: Albany, NY, 1988.

Instructional Sequence	Technology Education: Research and Design		
	Assignments	**Equipment, Tools, and Supplies**	**Facilities Requirements/ Modifications**
Day 1	Complete Pretest Read Assignments to Turn In, Goal, Words You Should Know, Expected Learner Outcomes, Objectives, Related TSA Competitive Events, Academic and Workplace Applications	Computer score card/sheet #2 Pencil	
Day 2	Read Information Sheet Complete Objective 1: Measure dimensions in metric units Answer Study Questions Complete Objective 2: Draw rough sketches Complete Objective 3: Draw a refined sketch	Computer score card/sheet for Activity 1 Metric ruler Paper: 8.5" x 11", min. 2 sheets Pencil Wooden body blank	
Day 3	Complete Objective 4: Transfer design to body blank	Safety glasses/goggles Wooden body blank Refined sketch of dragster — top and side view Scissors Masking tape: 1 roll Pencil	
Day 4	Complete Objective 5: Drill holes for axles in body blank Complete Objective 6: Cut out rough shape of design from wooden body blank	Drill press Wooden body blank with design Safety glasses/goggles Drill bit: 3/16" Scratch awl Bandsaw or jig saw	

Instructional Sequence	Technology Education: Research and Design		
	Assignments	**Equipment, Tools, and Supplies**	**Facilities Requirements/ Modifications**
Day 5	Complete Objective 7. Complete final shaping and smoothing of dragster.	Roughly shaped dragster body Wood files — various sizes Sandpaper: 80d, 120d, 220d Safety glasses/goggles	
Day 6	Complete Objective 8. Paint the dragster.	Paint Filter mask Safety glasses or goggles Optional: decals, airplane paint, various brushes	
Day 7	Complete Objective 9. Assemble the Metric 500 dragster.	Painted racer body Rod for axles: 1/8" Pencil Wheel bearings (4) Paper tubes — drinking straws (2) Racing wheels (4) Screw eyes (2) Scratch awl Safety glasses/goggles Hacksaw	
Day 8	Read Impact Statements Complete Career Search Activity Complete any unfinished assignments Take Posttest	Computer score card/sheet for Posttest #2 pencil	

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LESSON PLAN

INSTRUCTOR'S SECTION

Instructional Sequence	Technology Education: Research and Design		
	Assignments	**Equipment, Tools, and Supplies**	**Facilities Requirements/ Modifications**
Skunk Works	Construct a Windmobile	Safety glasses 3 pieces of wood (¼" x ¼" x 36") 4 plastic wheels 9" of axle rod Mylar 12" x 12" Soda straw Hot glue gun Glue stick Model cement Drill press Jig saw Sander Fasteners Pencil Heavy duty shop vacuum	

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Equipment, Tools, and Supplies:
Summary Worksheet

Equipment, Tools, and Supplies	Per Student	Per Period	Total Needed	Special Considerations	Cost per Student	Cost per Period	Total Cost	Special Considerations
Bandsaw or jig saw	1	1	1					
Drill press	1	1	1					
Drill bit (3/16")	1	1	12	Damage (11);				
Metric ruler	1	1	3	Breakage (2)				
Pencil	1	1	3	Breakage (2)				
Safety glasses/goggles	1	1	1					
Scratch awl	1	1	1					
Wood files (various sizes)	1	1	1					
Hacksaw	1	1	1					
Computer score card/sheet	1	24	24					
Paper (8.5" x 11")	3	72	96	Mistakes (24)				
Wooden body blank	1	24	24					
Masking tape (roll)	1	24	24					
Sandpaper (80d, 120d, 220d)	1	(for 24)	(for 24)					
Paint	1	(for 24)	(for 24)					
Dowel rod (1/8" diameter)	1	1	1					
Wheel bearings	4	96	96					
Paper tubes (drinking straws)	2	48	60	Breakage (12)				
Racing wheels	4	96	96					
Screw eyes	2	48	48					

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Equipment, Tools, and Supplies:
Summary Worksheet

Equipment, Tools, and Supplies	Per Student	Per Period	Total Needed	Special Considerations	Cost per Student	Cost per Period	Total Cost	Special Considerations
Heavy duty shop vacuum	1	1	1					
Assorted fasteners	1	(for 24)	(for 24)					
Wood ¼" x ¼" x 36"	3	72	72					
Plastic wheels	4	96	96					
⅛" diameter axle rod, 9" long	1	24	24					
12" x 12" Mylar	1	24	24					
Hot glue gun	1	1	1					
Glue stick	1	24	24					
Model cement	1	(for 24)	(for 24)					

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PRETEST

1. Ten millimeters are equal to:

   a. 1 centimeter
   b. 2 centimeters
   c. 2 decimeters
   d. 1 inch

2. When building the Metric 500 dragster, specifications refer to

   a. dimensions
   b. limitations
   c. speed
   d. weight

3. The definition for wheel base is

   a. distance between axles
   b. height of car
   c. length of car
   d. width of wheels

INSTRUCTOR'S SECTION

PART 1

PRETEST

INSTRUCTOR'S SECTION

PART 2

4. A refined sketch is a:

   a. pattern
   b. rough drawing
   c. rough drawing that is color coded
   d. sketch drawn to specifications

5. A tether line is used to

   a. guide dragster
   b. propel dragster
   c. slow dragster
   d. turn dragster

6. The refined sketch consists of three views — top, side, and front view when designing the metric dragster.

   a. TRUE
   b. FALSE

7. The saw used to cut the design on the body blank is the

   a. bandsaw
   b. coping saw
   c. radial arm saw
   d. table saw

PRETEST

INSTRUCTOR'S SECTION

PART 3

8. The thickness of the power plant housing must be:

   a. 3mm
   b. 4mm
   c. 5mm
   d. 6mm

9. The minimum height of the dragster with wheels is 60mm

   a. TRUE
   b. FALSE

10. The metric system will be one of the most commonly used measuring systems in future years.

    a. TRUE
    b. FALSE

Spaces on the answer sheet from 11-20 will be used for Objective 1 answers.

POSTTEST

21. Ten millimeters are equal to:

    a. 1 centimeter
    b. 2 centimeters
    c. 2 decimeters
    d. 1 inch

22. When building the Metric 500 dragster, specifications refer to

    a. dimensions
    b. limitations
    c. speed
    d. weight

23. The definition for wheel base is

    a. distance between axles
    b. height of car
    c. length of car
    d. width of wheels

INSTRUCTOR'S SECTION

PART 1

POSTTEST

INSTRUCTOR'S SECTION

PART 2

24. A refined sketch is a:

    a. pattern
    b. rough drawing
    c. rough drawing that is color coded
    d. sketch drawn to specifications

25. A tether line is used to

    a. guide dragster
    b. propel dragster
    c. slow dragster
    d. turn dragster

26. The refined sketch consists of three views — top, side, and front view when designing the metric dragster.

    a. TRUE
    b. FALSE

27. The saw used to cut the design on the body blank is the

    a. bandsaw
    b. coping saw
    c. radial arm saw
    d. table saw

POSTTEST

28. The thickness of the power plant housing must be:

    a. 3mm
    b. 4mm
    c. 5mm
    d. 6mm

29. The minimum height of the dragster with wheels is 60mm.

    a. TRUE
    b. FALSE

30. The metric system will be one of the most commonly used measuring systems in future years.

    a. TRUE
    b. FALSE

INSTRUCTOR'S SECTION

PART 3

POSTTEST

31. Wheel base
32. Axel
33. Power plant
34. Jigs and Fixtures
35. Tether hooks
36. Maximum
37. Overall height
38. Self-proppelled
39. Demensions
40. CO^2 cartrige

INSTRUCTOR'S SECTION

SPELLING TEST

TEST ANSWERS

1. A
2. B
3. A
4. D
5. A

6. A
7. A
8. A
9. B
10. A

11. C
12. D
13. A
14. B
15. A

16. D
17. B
18. A
19. B
20. A

INSTRUCTOR'S SECTION

PRETEST ANSWERS

OBJECTIVE 1 ANSWERS

TEST ANSWERS

21. A
22. B
23. A
24. D
25. A

26. A
27. A
28. A
29. B
30. A

31. B
32. B
33. A
34. A
35. A

36. A
37. A
38. B
39. B
40. B

INSTRUCTOR'S SECTION

POSTTEST ANSWERS

EVALUATION SUMMARY

10 POINTS EACH:

Pretest _____

Career Search _____

Objective 1: Measure dimensions in metric units. _____

Objective 2: Draw rough sketches of a Metric 500 dragster. _____

Objective 3: Transfer dragster design to the Metric 500 body blank. _____

Objective 4: Drill holes for axles. _____

Objective 5: Cut out rough shape of design from Metric 500 body blank. _____

Objective 6: Complete final shaping and smoothing of dragster body. _____

Objective 7: Paint the dragster body. _____

Objective 8: Assemble the Metric 500 Dragster. _____

INSTRUCTOR'S SECTION

1. PROCESS EVALUATION

1. PROCESS EVALUATION SCORE _____

EVALUATION SUMMARY

The instructor is encouraged to individualize the TLA to address the specific needs of each student, considering age and ability level. In addition to the specific areas on the chart, the instructor should take into account the student's desire, enthusiasm, etc.

Evaluation based upon observed performance = 40 possible points.

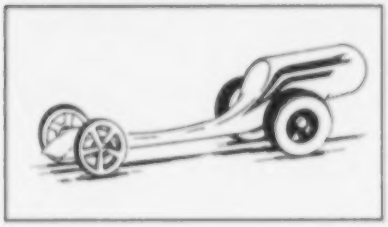
EVALUATION RATING TABLE

Student Name: _____

Criteria	Points Possible	Points Earned
Design Appearance	3	_____
Finish	3	_____
Drawing Accuracy	10	_____
Neatness	2	_____
Dimensions	2	_____
Point-to-point contact	2	_____
Line thickness	2	_____
Irregular curves	2	_____
Craftsmanship, etc.	14	_____

INSTRUCTOR'S SECTION

2. PRODUCT EVALUATION



2. PRODUCT EVALUATION SCORE _____

EVALUATION SUMMARY

Use the conversion table below to convert Product Evaluation scores to percentiles.

40 = 100%
39 = 97.5
38 = 95
37 = 92.5
36 = 90

35 = 87.5
34 = 85
33 = 82.5
32 = 80

31 = 77.5
30 = 75
29 = 72.5
28 = 70

27 = 67.5
26 = 65
25 = 62.5
25 = 60

INSTRUCTOR'S SECTION

2. PRODUCT EVALUATION
(Continued)

CONVERSION TABLE

EVALUATION SUMMARY

Posttest score = _____

INSTRUCTOR'S SECTION

3. WRITTEN EVALUATION

3. WRITTEN EVALUATION SCORE _____

EVALUATION WORKSHEET

1. Process evaluation score = _____

2. Product evaluation score = _____

3. Written evaluation score = _____

4. Total score = _____

Divide Total Score by 3 to get TLA score.

Total Score for TLA =

1 + 2 + 3 = TLA Score

Total Score /3 = SCORE

TLA SCORE _____

BIBLIOGRAPHY

Fales, James F. *Technology: Today and Tomorrow*, Glencoe Publishing Company: Mission Hills, CA, 1988.

Hacher, Michael and Robert Borden, *Living with Technology*, Delmar Publishers, Inc.: Albany, NY, 1988.

INSTRUCTOR'S SECTION

TECHNOLOGY EDUCATION

TECHNOLOGY

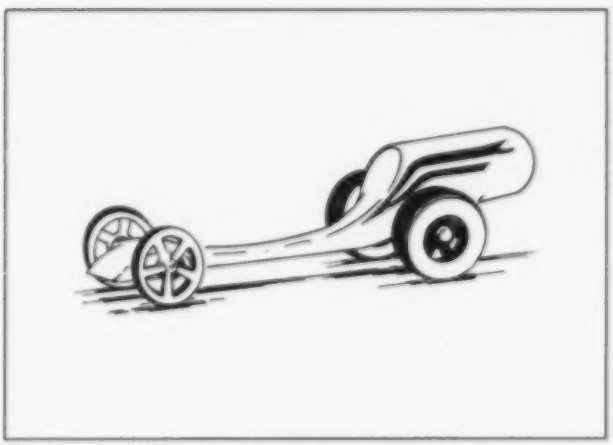
LEARNING

ACTIVITY

TE3101

RESEARCH AND DESIGN

Suggested Time: 8 Days



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Oklahoma Department of Vocational and Technical Education

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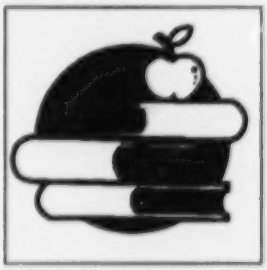
TECHNOLOGY EDUCATION RESEARCH AND DESIGN

DAY 1 ACTIVITIES

On Day 1 you should complete the following activities:

1. Complete Pretest
2. Read Assignments to Turn In (items to complete in 8 days)
3. Read Goal
4. Read Words You Should Know
5. Read Expected Learner Outcomes
6. Read Objectives
7. Read Related TSA Competitive Events
8. Read Academic and Workplace Applications

SUMMARY OF ACTIVITIES

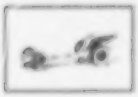


Reading Comprehension Skills:
- Gain factual information
- Make generalizations
- Distinguish fact, opinion, and inference

Functional Reading Skills:
- Follow written instructions

TECHNOLOGY EDUCATION RESEARCH AND DESIGN

DAY 1 ACTIVITIES



PRETEST

INSTRUCTIONS

You will need a computer scan sheet or card to record your answers to the following Pretest. Be sure to write your name, the title of the TLA, the date, and the class period on the computer scan sheet or card using a #2 pencil. Use rows 1-10 to record the answers to the Pretest. If your answers will be hand-scored, use a blank sheet of notebook paper to record your answers and number your answers 1-10.

Get the Pretest Questions from your instructor.

When you finish the Pretest, return the test form and the computer scan card or notebook paper to your instructor.

TECHNOLOGY EDUCATION RESEARCH AND DESIGN

DAY 1 ACTIVITIES

At the end of 8 days, you should give the following items to your instructor for evaluation:

1. **Computer score card/sheet, with answers to the following:**
   a) Pretest
   b) Study Questions
   c) Posttest (including Spelling Test)

2. **Rough Sketches — 5 to 8 sketches of dragster**

3. **Refined Sketches**
   a) Top view
   b) Side view

4. **Dragster**

5. **Career Search Activity**
   a) Two occupations identified
   b) Explanation of why those occupations appealed to you

ASSIGNMENTS TO TURN IN

TECHNOLOGY EDUCATION RESEARCH AND DESIGN

DAY 1
ACTIVITIES

GOAL

The Research and Design TLA will help you learn the importance to business and industry of the research and design processes. You will apply the same general procedures in designing and building your dragster that vehicle design companies apply in designing and building vehicles for highway use.

TECHNOLOGY EDUCATION RESEARCH AND DESIGN

DAY 1 ACTIVITIES

WORDS YOU SHOULD KNOW

Aerodynamics — the motion of gases around and the forces the gases exert upon objects in motion.

Axle - Pin or shaft on which wheel turns.

By-product — something produced in addition to the intended product.

Combustion — chemical process of burning (for example: the burning of gasoline in an automobile engine).

Friction — two things rubbing against each other. Friction in automobiles slows the turning of the axles and reduces the ability of the auto to move easily through air.

Jigs and fixtures - Devices used to position and hold parts to ensure that an operation is done the same way every time.

Limitation — says where each part of the something is allowed to be. For example, an axle hole must be between 3.5 mm and 9 mm from the bottom of the car. The limitations are 3.5 mm and 9 mm.

Maximum - Upper limit allowed.

Minimum - Lowest limit allowed.

— Continued —

TECHNOLOGY EDUCATION RESEARCH AND DESIGN

DAY 1 ACTIVITIES

WORDS YOU SHOULD KNOW

Overall width - measurement of dragster from side to side.

Overall height - Distance from ground to top of dragster.

Overall length - Distance from front to rear of dragster.

Power plant - Engine and related parts supplying the power of a self-propelled object. The power plant of a Metric 500 dragster is a CO_2 cartridge housed in a hole called the power plant chamber.

Power plant housing - Safety zone thickness of 3 millimeters around power plant chamber.

Tether hooks - Screw eyes attached to underside of dragster to control forward movement along tether line.

Tether line - cord between start and finish gates used to guide dragster in straight-line travel.

Wheelbase - Distance between front and rear axles.

Specifications - Detailed and exact statement describing materials, dimensions, and workmanship for something to be built.

TECHNOLOGY EDUCATION RESEARCH AND DESIGN

DAY 1
ACTIVITIES

EXPECTED LEARNER OUTCOMES

- You will come to know and appreciate the importance of Technology and technological literacy.
- You will explore career opportunities so you can make meaningful occupational choices.
- You will explore future educational opportunities so you can make meaningful educational choices.
- You will apply problem-solving and critical thinking techniques.
- You will apply math, science, reading, and other school subjects in a practical situation.
- You will develop basic skills in the safe and proper use of tools, machines, materials, processes, and technical concepts.
- You will recognize and develop individual talents.
- You will think logically and sequentially.
- You will develop leadership, creative abilities, positive self-concepts, and individual potential in a technological society.

— Continued —

TECHNOLOGY EDUCATION RESEARCH AND DESIGN

DAY 1 ACTIVITIES

EXPECTED LEARNER OUTCOMES

- You will become a more sophisticated consumer of the goods and services of a technological society.
- You will adjust to a changing technological environment.
- You will develop an understanding of and the ability to adapt to those technological forces that influence life in the 21st Century.
- You will communicate by making clear and relevant points through the development of mental process skills.
- You will think globally and act locally.
- You will develop an understanding of economic development.
- You will learn applications of lifelong learning skills.
- You will explore the organization and management systems of business and industry.

TECHNOLOGY EDUCATION RESEARCH AND DESIGN

DAY 1
ACTIVITIES

OBJECTIVES

At the completion of this Technology Learning Activity you should be able to:

1. Using information and procedure given, measure dimensions in metric units.

2. Using information given and your imagination, draw rough sketches of a Metric 500 dragster design.

3. Using your best rough sketch, draw a refined sketch of a Metric 500 dragster to specifications.

4. Using the materials and procedure outlined, transfer the dragster design to the Metric 500 body blank.

5. Using drill bit, scratch awl, and drill press, drill holes for axles in Metric 500 body blank.

6. Cut out rough shape of design from Metric 500 body blank using your refined sketch as a pattern.

7. Using the tools and materials listed, complete final shaping and smoothing of dragster.

— Continued —

TECHNOLOGY EDUCATION RESEARCH AND DESIGN

DAY 1 ACTIVITIES

8. Using your choice of paints and brushes, paint the dragster.

9. Using the materials listed, assemble the Metric 500 dragster.

OBJECTIVES

TECHNOLOGY EDUCATION RESEARCH AND DESIGN

DAY 1 ACTIVITIES

The following TSA Competitive Event applies to your study of Research and Design:

- Research and Design (Metric 500)

See *TSA Competitive Events Guidelines* for specific details on the competition.

Related TSA Competitive Event

TECHNOLOGY EDUCATION RESEARCH AND DESIGN

DAY 1
ACTIVITIES

The symbols in the right column are used to identify the Academic and Workplace Applications that are reinforced by specific activities in this TLA.

ACADEMIC AND WORKPLACE APPLICATIONS

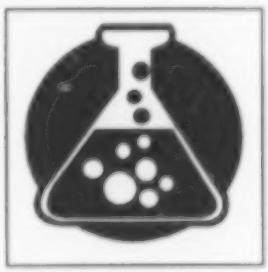
Math Skills Applied:

Functional Math Skills:

- Make measurements
- Solve practical problems

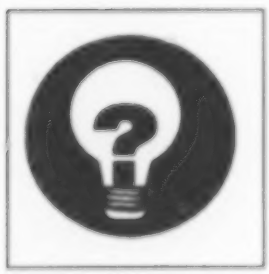
Science Skills Applied:

- Apply physical laws



Creative Thinking and Problem Solving Skills Applied:

- Create a finished product
- Evaluate alternatives
- Predict results



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TECHNOLOGY EDUCATION RESEARCH AND DESIGN

DAY 1 ACTIVITIES

ACADEMIC AND WORKPLACE APPLICATIONS

Reading Skills Applied:

Reading Comprehension Skills:
- Gain factual information
- React to written material

Functional Reading Skills:
- Follow written instructions
- Use content area vocabulary

Job Development Skills Applied:
- Master specific job task
- Develop good work habits

If you finish Day 1 Activities with time left over, you may begin Day 2 Activities.

TECHNOLOGY EDUCATION RESEARCH AND DESIGN

DAY 2 ACTIVITIES

On Day 2 you should complete the following activities:

1. Read Information Sheet
2. Complete Objective 1
5. Answer Study Questions
3. Complete Objective 2
4. Complete Objective 3

SUMMARY OF ACTIVITIES

Math Application Skills:
- Use metric measures
- Apply techniques of scaling
- Apply geometry principles

Data Analysis and Display Skills:
- Record data

TECHNOLOGY EDUCATION RESEARCH AND DESIGN

DAY 2
ACTIVITIES

INFORMATION SHEET

INTRODUCTION

This is your chance to design and build the fastest racing machine in your school. If your car is one of the fastest it could also qualify to race at regional and state competition. This is a Technology Student Association competitive event. Follow the instructions very carefully — especially the instructions about measurements and the limitation portion of the information sheets.

The limitations say where each part of the Metric 500 Dragster is allowed to be. For example, an axle hole must be between 3.5 mm and 9 mm from the bottom of the car. The limitations are 3.5 mm and 9 mm. If your dragster does not meet the limitation requirements, it will be disqualified. All of the limitations are on the next page. If you are not sure about what any of the limitations mean, refer to Words You Should Know on Day 1 or ask your instructor.

— Continued —

TECHNOLOGY STUDENT ASSOCIATION
METRIC 500 DRAGSTER SPECIFICATIONS

DESIGN FACTOR	LIMITATIONS	
	MAXIMUM	MINIMUM
Axles, diameter	3 mm	3 mm
Axles, length	75 mm	42 mm
Axles Bearing, diameter	4.5 mm	3.5 mm
Axle Hole, diameter	4.5 mm	3.5 mm
Axle Hole, height above body bottom	9 mm	3.5 mm
Axle Hole, distance from end of body	100 mm	9 mm
Brass Spacer Bearing, diameter	9 mm	7 mm
Dragster Body, length	305 mm	200 mm
Dragster Body, mass with wheels	170.1 g	30 g
Dragster Body, height with wheels	75 mm	
Dragster Body, width at axles	42 mm	35 mm
Power Plant, depth of hole	51 mm	51 mm
Power Plant Housing, thickness	3 mm	3 mm
Power Plant Housing, diameter	20 mm	19 mm
Power Plant C/L, from body bottom	35 mm	31 mm
Screw Eye, eyelet inside diameter	5 mm	3 mm
Screw Eyes (2) on C/L of bottom, distance apart	270 mm	155 mm
Wheels, Front, diameter	37 mm	32 mm
Wheels, Front, width of greatest diameter	5 mm	2 mm
Wheels, Rear, diameter	40 mm	30 mm
Wheels, Rear, width at greatest diameter	18 mm	15 mm
Wheelbase	270 mm	105 mm

C/L -- Center Line

Source: TSA Competitive Events Guidelines, Technology Student Association (1990), pp. 115 - 116.

TECHNOLOGY EDUCATION RESEARCH AND DESIGN

DAY 2 ACTIVITIES

When planning your Metric 500 Dragster, you need to remember three principles which will help your chances of building a winning car. These are

- Aerodynamic design
- Friction on the wheels and axles
- Dragster weight

Aerodynamic design: If you think of almost any new car, you will see that it is very smooth, with no sharp edges or flat sides. This shaping (called streamlining) reduces the amount of friction between the car and the air, so it can go faster. If the car has a flat front, like a semi-tractor, the wind friction holds the vehicle back and keeps it from going very fast.

Friction on the wheels and axles: If you hold a pencil very loosely between your fingers, it is easy to turn. If you increase the pressure of your fingers, the pencil gets harder to turn. The pressure of your fingers on the pencil is like friction on wheels and axles. You can use pencil lead (also called graphite) to reduce this friction.

Dragster weight: The heavier the dragster is, the more power is needed to move it. If you make a light dragster, more power can be used for speed, instead of just trying to move the vehicle.

— Continued —

TECHNOLOGY EDUCATION RESEARCH AND DESIGN

DAY 2 ACTIVITIES

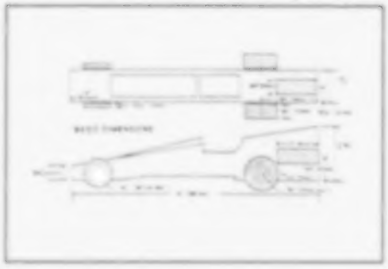
Building a dragster involves several steps to get from your original idea to the final product.

The first step is to make several very small sketches of your disign. These are called "thumbnail" sketches, because they should be about as big as your thumbnail.

Next you will make a refined sketch from your thumbnail sketches. This will be full-size and look just like the final product as viewed from the top, side, and front. When you are drawing this sketch, you must use the correct limitations from the chart in this section.

All of these limitations use metric measurements. On the next page, you will review using metric measurements, to make it easier to build your Metric 500 Dragster.

METRIC 500 BASIC DIMENSIONS



TECHNOLOGY EDUCATION RESEARCH AND DESIGN

DAY 2 ACTIVITIES

OBJECTIVE 1

Using information and procedure given, measure dimensions in metric units.

INTRODUCTION

One important factor in building your dragster is the ability to read a metric ruler. This is very important because all limitations are given in millimeters. Each little mark on the ruler is a millimeter and it takes 10 millimeters to make 1 centimeter. Take a minute and become familiar with the metric ruler. If you have any questions, ask for instructor's assistance.

International system of metric measurement (SI metrics) — In this system the scale is divided into millimeters and centimeters.

The SI metric system will be the one most commonly used in future years. You should learn to read both U.S. customary and SI metric scales to measure lengths.

TOOLS AND MATERIALS

- Metric Ruler
- #2 Pencil
- Paper for notes

TECHNOLOGY EDUCATION RESEARCH AND DESIGN

DAY 2 ACTIVITIES

PROCEDURE

FOLLOW THESE STEPS:

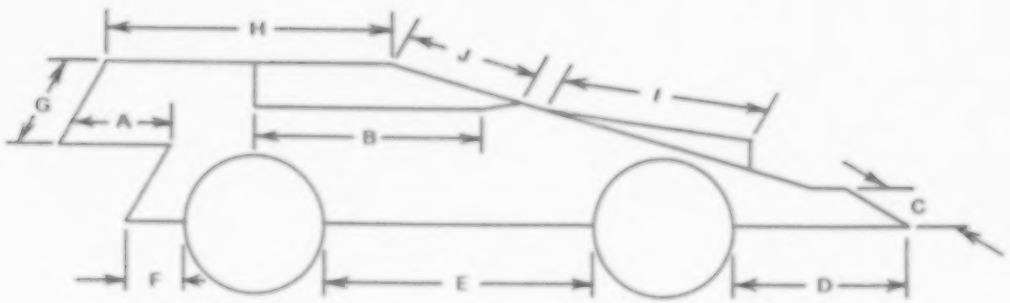
STEP 1: You will need a computer score sheet or card to record the answers to this exercise. Be sure to use a #2 pencil and make your marks dark.

NOTE: If answers to this objective are hand-scored, use a sheet of notebook paper numbered from 11 to 20. Be sure to put your name, period, and TLA title on the sheet before handing it in.

STEP 2. Using a metric ruler, measure the dimensions of the lettered lines of the dragster. Answer the questions on the pages 22 and 23, using rows 11-20 on your computer score sheet or card to record your answers.

STEP 3: Use the drawing on the next page to measure dimensions and get answers for the Study Questions on the following pages.

MEASURE DIMENSIONS HERE



STUDY QUESTIONS

11. Line A is

    a. 10 mm
    b. 12 mm
    c. 15 mm
    d. 30 mm

12. Line B is

    a. 5 mm
    b. 12 mm
    c. 20 mm
    d. 34 mm

13. Line C is

    a. 11 mm
    b. 13 mm
    c. 35 mm
    d. 40 mm

14. Line D is

    a. 10 mm
    b. 25 mm
    c. 35 mm
    d. 40 mm

15. Line E is

    a. 40 mm
    b. 45 mm
    c. 48 mm
    d. 50 mm

— Continued —

STUDY QUESTIONS

16. Line F is

a. 5 mm
b. 7 mm
c. 8 mm
d. 9 mm

17. Line G is

a. 13 mm
b. 15 mm
c. 22 mm
d. 25 mm

18. Line H is

a. 42 mm
b. 52 mm
c. 55 mm
d. 60 mm

19. Line I is

a. 25 mm
b. 30 mm
c. 40 mm
d. 100 mm

20. Line J is

a. 2.0 cm
b. 2.3 cm
c. 2.5 cm
d. 2.6 cm

TECHNOLOGY EDUCATION RESEARCH AND DESIGN

DAY 2 ACTIVITIES

OBJECTIVE 2

Using information given and your imagination, draw rough sketches of a Metric 500 dragster design.

INTRODUCTION

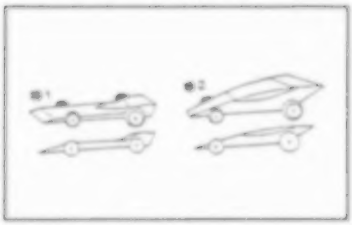
In this activity you will prepare a small rough sketch of your dragster (called a thumbnail sketch) and then refine the sketch to specifications and limitations.

TOOLS AND MATERIALS

- Pencil
- Paper

FOLLOW THESE STEPS:

STEP 1: Obtain a piece of 8½" x 11" paper and draw 5 - 8 rough sketches of different car designs. These sketches need to be kept small, about the size of your thumbnail. As the car is designed, consider factors which increase or decrease the speed and strength of the dragster.



STEP 2: Select the sketch that you like best and move on to the next objective.

TECHNOLOGY EDUCATION RESEARCH AND DESIGN

DAY 2 ACTIVITIES

OBJECTIVE 3

Using your best rough sketch, draw a refined sketch of a Metric 500 dragster to specifications.

TOOLS AND MATERIALS

- Pencil
- Paper
- Wooden body blank
- Metric ruler

PROCEDURE

FOLLOW THESE STEPS:

IMPORTANT
YOU NEED BOTH A TOP VIEW, A SIDE VIEW, AND A FRONT VIEW.

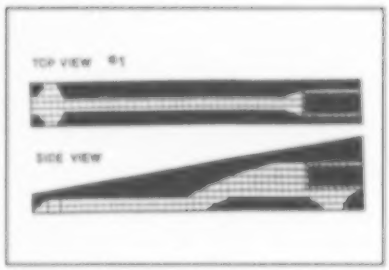
STEP 1: Refining sketches is a very important step in the design process. Refined sketches should use the ideas expressed in rough sketches and should be drawn to exact specifications in preparation for manufacturing.

TECHNOLOGY EDUCATION RESEARCH AND DESIGN

DAY 2 ACTIVITIES

FOLLOW THESE STEPS:

STEP 2: Now you are ready to make the refined sketch. Carefully draw your dragster design on another sheet of paper. You may want to use the test car block and trace around the outside of the block. This will give you a size with which to work. Refer to the Specifications Sheet in the Information Sheet to find the limitations.



STEP 3: Use your metric ruler to measure and start measuring your limitations. Transfer these measurements to the drawing to refine your sketch.

STEP 4: You should produce 3 refined sketches of the dragster. One refined sketch is a side view correctly dimensioned; one refined sketch is a top view correctly dimensioned; and one refined sketch is a front view correctly dimensioned.

If you have any questions about what a measurement means, refer to the Words You Should Know from Day 1.

TECHNOLOGY EDUCATION RESEARCH AND DESIGN

DAY 2 ACTIVITIES

FOLLOW THESE STEPS:

STEP 5: When you have finished, check your dragster design against the specifications or limitations sheet to see if your dragster meets all requirements.

IMPORTANT

Make sure your dragster meets all of the limitations in the chart, otherwise your dragster will be disqualified from competition.

STEP 6: Give your dragster design to your instructor.

If you finish Day 2 Activities with time left over, you may begin Day 3 Activities.

TECHNOLOGY EDUCATION RESEARCH AND DESIGN

DAY 3 ACTIVITIES

On Day 3 you should complete the following activity:

1. Complete Objective 4

SUMMARY OF ACTIVITIES

- Create a finished product
- Evaluate results

TECHNOLOGY EDUCATION RESEARCH AND DESIGN

DAY 3
ACTIVITIES

OBJECTIVE 4

Using the materials and procedure outlined, transfer the dragster design to the Metric 500 body blank.

INTRODUCTION

Take the refined design you did in Objective 3 and transfer it to the Metric 500 body blank using the procedures described.

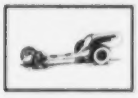
If you are using a Metric 500 kit, you may practice with the styrofoam block before making the final design on the body blank.

TOOLS AND MATERIALS

- Protective glasses or goggles
- Wooden body blank
- Refined sketch of Metric 500 dragster
- Scissors
- Masking tape
- Pencil

TECHNOLOGY EDUCATION RESEARCH AND DESIGN

DAY 3 ACTIVITIES

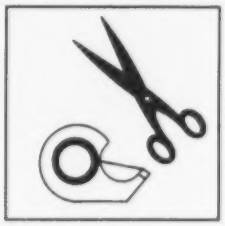


PROCEDURE

FOLLOW THESE STEPS:

STEP 1: Put on protective glasses or goggles.

STEP 2: Cut out patterns for top view and side view from the 8½" x 11" refined sketches.



STEP 3: Tape refined sketch of top view on body blank and trace around pattern with pencil.

TECHNOLOGY EDUCATION RESEARCH AND DESIGN

DAY 3 ACTIVITIES

STEP 4: Give the pattern and body blank to your instructor.

STEP 5: Remove patterns and clean up work area. Put tools and materials back in proper storage area.

If you finish Day 3 Activities with time left over, you may begin Day 4 Activities.

TECHNOLOGY EDUCATION RESEARCH AND DESIGN

DAY 4 ACTIVITIES

On Day 4 you should complete the following activities:

1. Complete Objective 5
2. Complete Objective 6

SUMMARY OF ACTIVITIES

Job Acquisition/Development Skills:

- Master specific job task
- Develop good work habits
- Develop self-confidence

TECHNOLOGY EDUCATION RESEARCH AND DESIGN

DAY 4
ACTIVITIES

OBJECTIVE 5

Using drill bit, scratch awl, and drill press, drill holes for axles in Metric 500 body blank.

INTRODUCTION

Now that you have attached your pattern to the body blank, you can drill the axle holes.

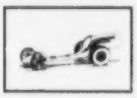
IMPORTANT

You have limitations for height of axle holes and how far in axle holes can be drilled from each end of body blank. FOLLOW SPECIFICATIONS.

If you need to check these measurements, refer to Specifications in the Information Sheet on Day 2.

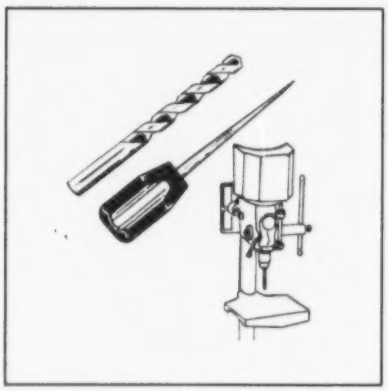
TECHNOLOGY EDUCATION RESEARCH AND DESIGN

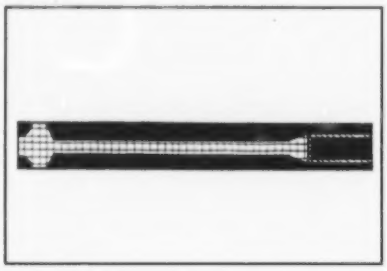
DAY 4 ACTIVITIES



TOOLS AND MATERIALS

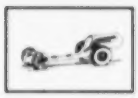
- Safety glasses/goggles
- Drill press
- Metric 500 wooden body blank with your pattern taped on it.
- 3/16-inch drill bit
- Scratch awl





TECHNOLOGY EDUCATION RESEARCH AND DESIGN

DAY 4 ACTIVITIES



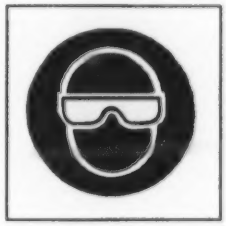
PROCEDURE

IMPORTANT
You will be working with some dangerous machines. READ HAZARD ALERT MESSAGES AND FOLLOW SAFETY PRECAUTIONS.

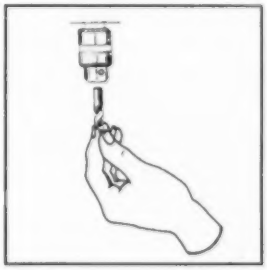
IMPORTANT
Get instructor's permission before operating power tools.

FOLLOW THESE STEPS:

STEP 1: Wear safety glasses or goggles.

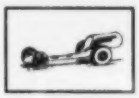


STEP 2: Insert 3/16-inch drill bit into drill press chuck.



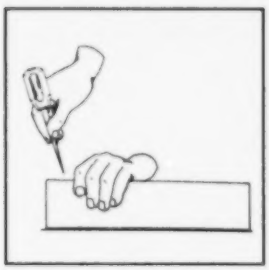
TECHNOLOGY EDUCATION RESEARCH AND DESIGN

DAY 4 ACTIVITIES



FOLLOW THESE STEPS:

STEP 3: Holding body blank securely against table, use a scratch awl to mark where holes are to be drilled through body blank.



IMPORTANT

If you need help with setup of drill press, ask instructor for help. INSTRUCTOR MUST CHECK SETUP OF DRILL PRESS BEFORE YOU OPERATE IT.

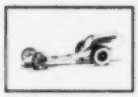
WARNING

MOVING DRILL BIT can mutilate or severely injure hands. FOLLOW SAFETY RULES.

STEP 4: Turn on drill press and drill front axle hole. TURN DRILL PRESS OFF WHEN FINISHED.

TECHNOLOGY EDUCATION RESEARCH AND DESIGN

DAY 4 ACTIVITIES



FOLLOW THESE STEPS:

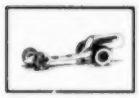
STEP 5: Repeat steps 3 - 4 to drill hole for rear axle. TURN DRILL PRESS OFF WHEN FINISHED.

STEP 6: When you finish, clean work area and return tools and materials to their proper storage areas.

Continue Day 4 Activities by completing Objective 6.

TECHNOLOGY EDUCATION RESEARCH AND DESIGN

DAY 4
ACTIVITIES



OBJECTIVE 6

Cut out rough shape of design from Metric 500 body blank using your refined sketch as a pattern.

If you are using a Metric 500 kit, you may practice cutting body blank using the styrofoam prototype that comes in the kit.

INTRODUCTION

To complete this objective, you will cut out the rough shape of the dragster design you selected and transferred to the body blank.

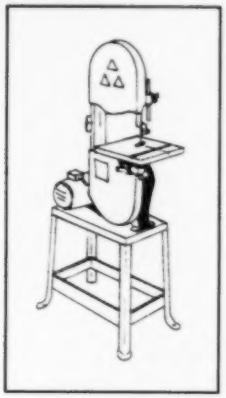
IMPORTANT
You will be working with some dangerous machines. READ HAZARD ALERT MESSAGES AND FOLLOW SAFETY PRECAUTIONS.

IMPORTANT
Get instructor's permission before operating power tools.

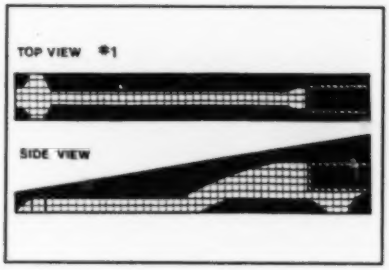
TECHNOLOGY EDUCATION RESEARCH AND DESIGN

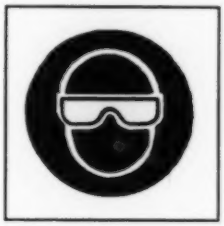
DAY 4 ACTIVITIES

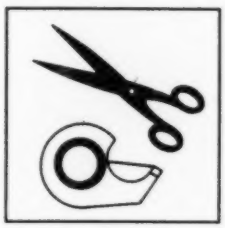
TOOLS AND MATERIALS



- Bandsaw or jig saw
- Metric 500 body blank with design drawn on it.
- Safety glasses or goggles
- Masking tape

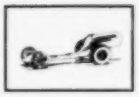






TECHNOLOGY EDUCATION RESEARCH AND DESIGN

DAY 4 ACTIVITIES

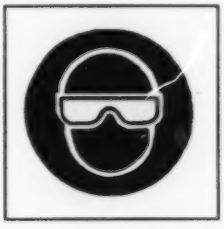


FOLLOW THESE STEPS:

PROCEDURE

WARNING
MOVING SAW BLADE can cut off fingers. FOLLOW SAFETY RULES.

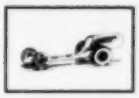
STEP 1: Wear safety glasses or goggles.



NOTICE
Do not cut into axle holes or CO_2 cartridge hole.

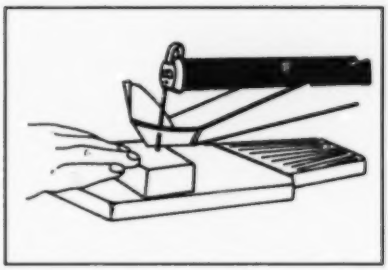
TECHNOLOGY EDUCATION RESEARCH AND DESIGN

DAY 4 ACTIVITIES

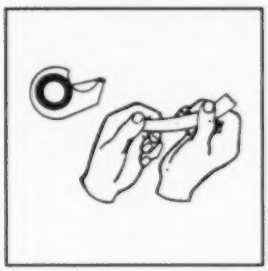


FOLLOW THESE STEPS:

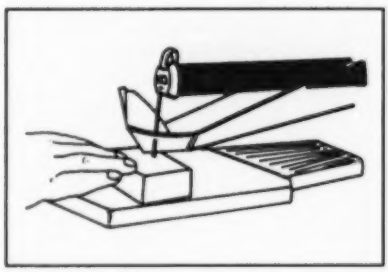
STEP 2: Using the band saw or jig saw, cut the side view of dragster on body blank.



STEP 3: After cutting side view, tape the parts that were cut from the body blank back in place with masking tape.



STEP 4: Cut top view from taped-together body blank.



TECHNOLOGY EDUCATION RESEARCH AND DESIGN

DAY 4 ACTIVITIES

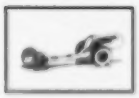
FOLLOW THESE STEPS:

STEP 5: When you finish, clean work area and return tools and materials to proper storage area. Return the dragster to your instructor.

If you complete Day 4 Activities with time left over, you may begin Day 5 Activities.

TECHNOLOGY EDUCATION RESEARCH AND DESIGN

DAY 5 ACTIVITIES



On Day 5 you should complete the following activity:

❶ Complete Objective 7

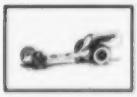
SUMMARY OF ACTIVITIES

Job Acquisition/Development Skills:

- Master specific job task
- Develop good work habits
- Develop self-confidence

TECHNOLOGY EDUCATION RESEARCH AND DESIGN

DAY 5 ACTIVITIES



OBJECTIVE 7

Using the tools and materials listed, complete final shaping and smoothing of dragster.

INTRODUCTION

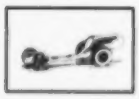
To complete this objective, you will put the final touches on the dragster body before painting. Follow the procedures for smoothing the dragster body.

TOOLS AND MATERIALS

- Roughly-shaped dragster body
- Various sizes of wood files
- Rough (80d), medium (120d), and fine (220d) sandpaper
- Safety glasses or goggles

TECHNOLOGY EDUCATION RESEARCH AND DESIGN

DAY 5 ACTIVITIES

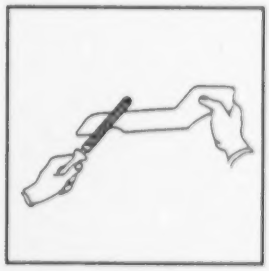


PROCEDURE

FOLLOW THESE STEPS:

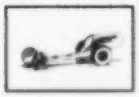
STEP 1: Wear safety glasses or goggles.

STEP 2: Complete final shaping with wood file — shape sides, top, bottom, and ends of dragster.



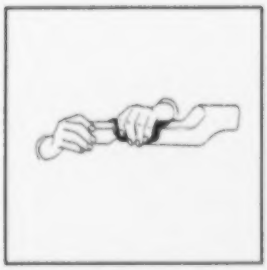
TECHNOLOGY EDUCATION RESEARCH AND DESIGN

DAY 5 ACTIVITIES

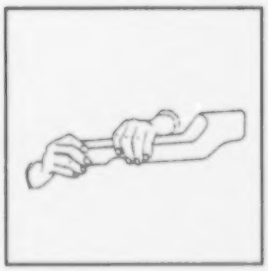


FOLLOW THESE STEPS:

STEP 3: Smooth surface with sandpaper — sand first with coarse (80d), then with medium (120d), and finally with fine (220d).



STEP 4: Rub your hand over surface to check smoothness. The body should be sanded as smooth as paper.



STEP 5: Sand the surface again if needed.

The dragster body should be quite smooth before you paint it. Paint will make any rough spots more obvious. Also, the smoother the car, the faster it will go.

TECHNOLOGY EDUCATION RESEARCH AND DESIGN

DAY 5 ACTIVITIES

FOLLOW THESE STEPS:

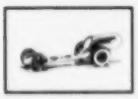
STEP 6: When you finish, clean work area and return tools and materials to their proper storage areas. Return the dragster to your instructor.

If you would like to customize your dragster, you may bring decals or airplane paint from home. You must bring the decals or paint tomorrow if you want to use them.

If you complete Day 5 Activities with time left over, you may begin Day 6 Activities.

TECHNOLOGY EDUCATION RESEARCH AND DESIGN

DAY 6 ACTIVITIES



On Day 6 you should complete the following activity:

1. Complete Objective 8

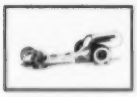
SUMMARY OF ACTIVITIES

Job Acquisition/Development Skills:

- Master specific job task
- Develop good work habits
- Develop self-confidence

TECHNOLOGY EDUCATION RESEARCH AND DESIGN

DAY 6
ACTIVITIES



OBJECTIVE 8

Using your choice of paints and brushes, paint the dragster.

INTRODUCTION

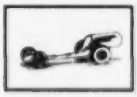
You may need help in painting the dragster. Ask your instructor for help. Two or three coats of paint will need to be applied. The instructor will show you how to do this.

TOOLS AND MATERIALS

- Paint
- Various brushes
- Safety glasses or goggles
- Filter mask

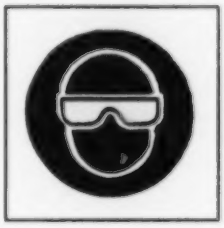
TECHNOLOGY EDUCATION RESEARCH AND DESIGN

DAY 6 ACTIVITIES

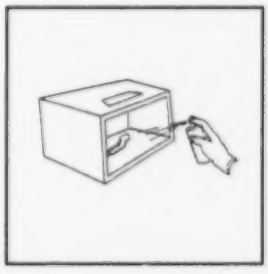


FOLLOW THESE STEPS:

PROCEDURE



STEP 1: Wear safety glasses or goggles.



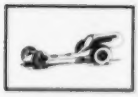
STEP 2: Paint inside painting booth or designated painting area. Wear filter mask.

STEP 3: When you finish, clean work area and put tools and materials back in proper storage area. Return the dragster to your instructor.

If you complete Day 6 Activities with time left over, you may begin Day 7 Activities.

TECHNOLOGY EDUCATION RESEARCH AND DESIGN

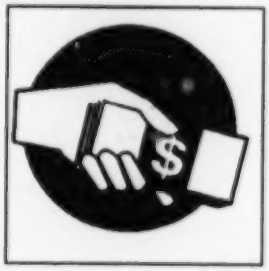
DAY 7 ACTIVITIES



On Day 7 you should complete the following activity:

➢ Complete Objective 9

SUMMARY OF ACTIVITIES



Job Acquisition/Development Skills:

- Master specific job task
- Develop good work habits
- Develop self-confidence

TECHNOLOGY EDUCATION RESEARCH AND DESIGN

DAY 7 ACTIVITIES

OBJECTIVE 9

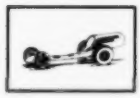
Using the materials listed, assemble the Metric 500 dragster.

INTRODUCTION

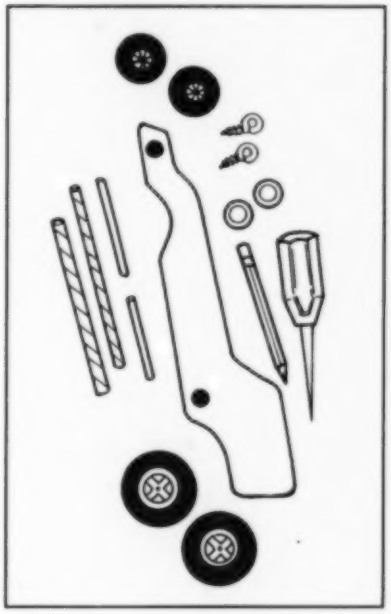
Now that your car is painted and it looks like you want it to look, it is time to assemble the parts. You will get the parts from your instructor. After you have your car parts, follow the procedure in this objective to assemble your Metric 500 dragster.

TECHNOLOGY EDUCATION RESEARCH AND DESIGN

DAY 7 ACTIVITIES



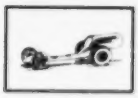
TOOLS AND MATERIALS



- Dragster body (painted)
- 1/8-inch diameter rod for axles
- Pencil
- Four wheel bearings (these look like little washers)
- Two paper tubes (these are drinking straws)
- Four racing wheels (two front and two back)
- Two screw eyes
- Scratch awl
- Safety glasses or goggles
- Hacksaw

TECHNOLOGY EDUCATION
RESEARCH AND DESIGN

DAY 7 ACTIVITIES



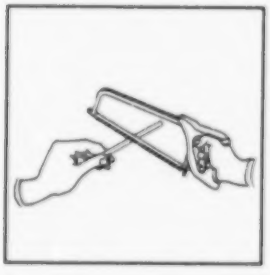
PROCEDURE

FOLLOW THESE STEPS:

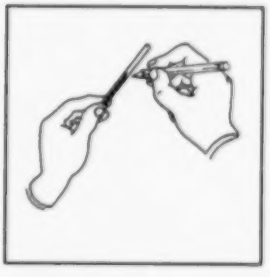
STEP 1: Wear safety glasses or goggles.

WARNING
SHARP BLADE. Saw can cut off hands or fingers. KEEP HANDS OUT OF BLADE PATH.

STEP 2: Cut axle rods to desired length. Use a hacksaw to do this step.

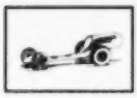


STEP 3: Rub axle with the pencil lead to lubricate the metal axle rod, by covering it with graphite.



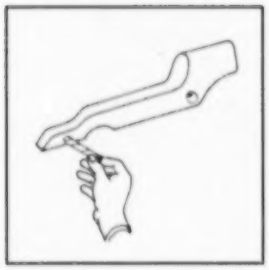
TECHNOLOGY EDUCATION
RESEARCH AND DESIGN

DAY 7
ACTIVITIES

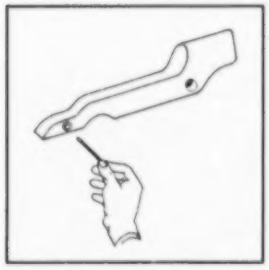


FOLLOW THESE STEPS:

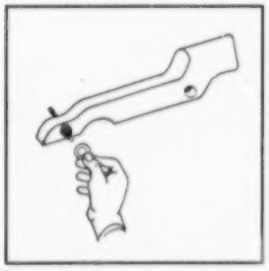
STEP 4: Insert straw axle bearing through drilled axle hole in dragster body.



STEP 5: Insert graphite-covered axle rod through straw axle bearing.



STEP 6: Place brass wheel bearings on axle rod sticking out of each side of the dragster body.

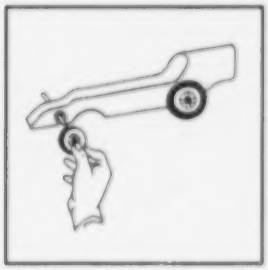


TECHNOLOGY EDUCATION RESEARCH AND DESIGN

DAY 7 ACTIVITIES

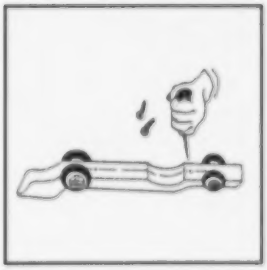
FOLLOW THESE STEPS:

STEP 7: Attach wheels by pressing them onto axles.



STEP 8: Check attached wheels to be sure they are straight on axle.

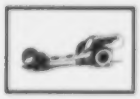
STEP 9: Apply tether hooks (screw eyes) on bottom of dragster body. Use a scratch awl to mark where screw eyes belong. Tether hooks should be located on centerline of bottom of body.



You have limitations on how far apart tether hooks may be placed. See Specifications page in the Information Sheet of Day 2.

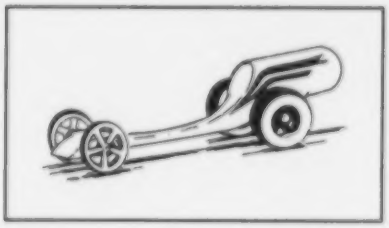
TECHNOLOGY EDUCATION RESEARCH AND DESIGN

DAY 7 ACTIVITIES



FOLLOW THESE STEPS:

STEP 10: When finished, clean up work area and put all tools and materials back into proper storage area. Return the dragster to your instructor.



If you finish Day 7 Activities with time left over, you may begin Day 8 Activities.

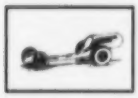
TECHNOLOGY EDUCATION RESEARCH AND DESIGN

On Day 8 you should complete the following activities:

1. Read Impact Statements
2. Complete Career Search Activity
3. Complete any unfinished assignments.
4. Complete Posttest

If time permits, complete the Skunk Works Activity.

DAY 8 ACTIVITIES



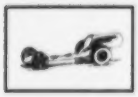
SUMMARY OF ACTIVITIES

Job Search/Selection Skills:

- Analyze personal occupational preferences
- Investigate requirements for a career field

TECHNOLOGY EDUCATION RESEARCH AND DESIGN

DAY 8 ACTIVITIES



ENVIRONMENTAL IMPACT

The design of vehicles affects the environment in many ways. For example, the aerodynamics of automobiles, engine efficiency, and other factors influence the amount of fuel used. Most vehicles operate on gasoline or diesel which are derived from natural resources. By economizing on the amount of fuel used, we save our world's natural resources.

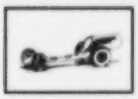
Another environmental effect involves how much the air is polluted by automobile exhausts. Combustion engine by-products are slowly raising the level of carbon monoxide in the air.

This has two primary effects on the environment. First, carbon monoxide, a poison, is not used by plants or animals, so it stays in the air.

The second effect is that increases in the level of carbon monoxide in the air produces what is called a "greenhouse effect," slowly raising the temperature of the air. This could result in melting of the ice caps and flooding of coastal areas; also it could eventually lead to the extinction of nearly all life on earth.

TECHNOLOGY EDUCATION RESEARCH AND DESIGN

DAY 8 ACTIVITIES



SOCIAL/CULTURAL IMPACT

Land transportation has come a long way since the earliest people had to walk from place to place. Now we can walk, pedal a bicycle, ride a motorcycle, drive a car, ride in a subway, fly in an airplane, or take a train. Goods can also be shipped in these ways.

Because of the many ways we can travel on land, our horizons are much broader today than in the old days when people had to walk or ride animals. We can more often visit friends and relatives in other cities or states. We can go to a school that is miles away from our house. We can shop at stores outside our neighborhood. We can take vacations to distant places. We can live in Maine and eat fruit grown in California. We can live in Kansas and eat fish caught off the Florida Keys. We can travel by air to any city in this country in just a few hours if we fly, or in just a few days if we drive.

TECHNOLOGY EDUCATION RESEARCH AND DESIGN

DAY 8 ACTIVITIES

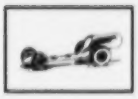
ECONOMIC IMPACT

A few countries in the Middle East and South America control the world's oil prices. These countries have formed an organization called OPEC (Oil Producing and Export Countries). During the mid-1970s OPEC imposed an oil embargo on the United States, and our nation saw the price of gas triple from about $0.33/gal to over $1.00/gal. Gas prices, due to many different factors, have changed constantly and risen consistently ever since.

Vehicle design changed with the oil prices, so that now vehicles which depend on oil for fuel are generally more aerodynamic and fuel efficient. Aerodynamics cuts down wind resistance so that a vehicle does not need as powerful an engine to push it through the air. Since aerodynamic vehicles do not need as much power, engines can be smaller, using less fuel to do the job.

TECHNOLOGY EDUCATION RESEARCH AND DESIGN

DAY 8 ACTIVITIES



POLITICAL IMPACT

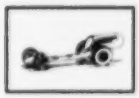
Federal and State laws regulate various aspects of automobile design and function. Safety factors, such as seat belts, are required in vehicles. All states require the use of seat belts and car seats. There are laws which set speed limits. There are laws regarding the weight that can be transported on certain roads. All of these laws and regulations must be taken into account when designing a new automobile.

ERGONOMIC IMPACT

Ergonomics means developing products and systems that are comfortable for people to use and that really fit their needs. For example, ergonomic design is used in the way automobile seats are constructed. The objective is to maximize human comfort while providing a good driving position. The height of the seat, the materials used for its construction, and the position of the arm rests and back are all based upon the physical size and shape of most drivers. Another example is a reconstructed van which accommodates a person's disability by allowing him/her to drive using lifts and adaptations for operating the vehicle.

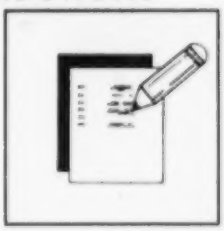
TECHNOLOGY EDUCATION RESEARCH AND DESIGN

DAY 8 ACTIVITIES



CAREER SEARCH ACTIVITY

INSTRUCTIONS



Using the *Career Search Abstracts*, find the occupations listed below. Select the two occupations that sound most appealing to you. On a seperate sheet of notebook paper, list the two occupations you selected and tell why. Remember to write using complete sentences, proper grammar, and correct spelling. Give the completed sheets to your instructor.

RELATED CAREERS

- Mathematician
- Mechanical Engineer
- Painter
- Woodworker

WOODWORKER

Nature of the Occupation

Woodworkers cut, shape, and assemble raw wood to make household components such as doors, windows, cabinets, trusses, plywood, flooring, paneling, molding, and trim; furnishings such as beds, tables, sofas, dressers, and chairs; and recreational items such as baseball bats, racquets, skis, oars, and surfboards; and such other items as musical instruments, toys, caskets, and tool handles.

Duties may include but are not limited to the following:

- Working from blueprints, drawings, and instructions from supervisors
- Setting up and running machines such as saws, planers, sanders, lathes, jointers, and routers
- Verifying dimensions and trimming parts with hand tools like planes, chisels, files, or sandpaper
- Joining wood parts with nails, glue, and clamps
- Installing hardware, staining, and painting
- Working in teams

Occupation Specialties

(Dot codes in parenthesis)

Wood-Carving Machine Operators (665.382-018) cut, shape, and assemble prepared parts of wood components into finished wood products.

Wood Lathe Operators (664.382-010) set up and operate lathes to shape pieces of wood for further use.

Wood Finishers (763.381-010) may nail, glue, fit, and clamp parts together to form a complete unit.

Working Conditions

Woodwork areas are well-lighted but noisy from machinery and power tools. Workers wear masks to prevent inhaling wood dust. Adherence to safety precautions reduces risk or injury from rough woodstock and the use of sharp tools and power equipment. Prolonged standing and the lifting and fitting of heavy objects are often required.

Some woodworkers join unions such as the International Woodworkers of America; the United Furniture Workers of America; and the United Brotherhood of Carpenters and Joiners of America.

Tools, Equipment and Materials used may include:

- Blueprints
- Planers
- Jointers
- Chisels
- Templates
- Production Machinery
- Power Saws
- Lathes
- Routers
- Clamps
- Calipers

Worker Requirements

You should like:

- Working with wood and tools

You should be able to:

- Work alone and with others
- Use power tools
- Read blueprints
- Use shop mathematics
- Perform accurate, neat work

Physically you must:

- See well, naturally or with correction
- Be able to stand for long periods

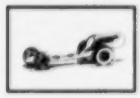
OCCUPATION SPECIALTIES

DOT CODE:

665.382-018 Wood Carving Machine Operator
763.381-010 Wood Finisher
664.382-010 Wood Lathe Operator

SOC CODE: 2421

OKLAHOMA CAREER SEARCH



WOODWORKER

- Lift heavy objects
- Withstand loud noise
- Handle, reach, finger, and feel objects

Opportunities for Experience:

On-the-job training is available, so most woodworkers learn informally from skilled workers. Vocational education and carpentry work on construction jobs provide other means of entry. The military also offers opportunities for experience.

Methods of Entry:

Direct application to employers, manufacturers, fabricators, mills, lumber dealers, furniture retailers, and repair shops, and construction firms is one way to enter. Jobs may also be found by reading newspaper want ads, school placement lists, and information from state employment offices.

Earnings and Advancement

Earnings depend on the woodworker's skills, experience, and region of employment.

Earnings:

Median weekly earnings for salaried full-time precision woodworkers were about $315 in 1990. The middle 50% earned between $239 and $446, while the lowest 10% earned less than $196 and the highest 10% earned over $576.

Woodworking machine operators had median weekly earnings of about $293 in 1990. The middle 50% earned between $217 and $370. The bottom 10% earned less than $174, and the top 10% earned over $456. Earnings were generally higher in mills in the Northwest.

Fringe Benefits:

Depending on the employer, woodworkers may receive paid vacations and holidays; life, accident, disability, and hospitalization insurance; retirement plans; and sick pay. These benefits are usually paid for, at least in part, by the employer.

Career Ladder for this Occupation may look like this:

- Partner/Own Business
- Inspector/Supervisor
- Specialist
- Worker
- Trainee

A trainee advances from helping and observing experienced workers to simple machine operations under close supervision. With experience, workers do more complex jobs with less supervision.

Employment and Outlook

About 227,000 woodworkers held jobs in 1988. Eight-five percent worked in manufacturing, 24 percent made furniture, 24 percent made structural wood, 12 percent worked in sawmills, and the rest worked in retail, repair, and construction. Most manufacturing jobs are in the South and Northwest.

Woodworking employment should grow more slowly than the average because of the increasing use of metal, plastic, fiberglass, and imports as well as automation. Openings will occur to replace workers leaving the trade.

Woodworkers held about 540 jobs in Oklahoma during 1986. That number is expected to increase to 602 by 1992, which represents a 5.98 percent change. Job openings each year for woodworkers will equal approximately 39, with 29 of those due to replacements and 10 created through new jobs.

Related Education and Training

Level(s) of education and training usually needed for this occupation:

- High school diploma or G.E.D.

Level(s) of education and training also available for this occupation:

- High school diploma with vocational education

School subjects helpful in preparing for this occupation include:

- Blueprint Reading
- Shop Math
- Building Trades and Carpentry
- Wood Shop

More Sources of Information

- International Woodworkers of America
  U.S. Research and Education Department
  25 Cornell Avenue
  Gladstone, OR 97027

- Local Manufacturers and Other Employers

- Local or Labor Unions

PAINTING & COATING MACHINE OPERATOR

Nature of the Occupation

Painting and coating machine operators use painting and coating machinery and equipment to apply finishes to machines and other manufactured products. In manufacturing, everything from cars to candy is covered by paint, plastic, varnish, chocolate, or some special coating solution to aesthetically enhance or protect and insulate products. Basic coating methods include dipping, tumbling barrels, and spray machines.

Duties may include but are not limited to the following:

- Cleaning items before painting them
- Figuring areas to be painted and the amount of paint to be mixed
- Making sure the paint is the right consistency
- Adjusting spray gun nozzles and other controls so the paint will be applied evenly

Occupation Specialties

(Dot codes in parenthesis)

Spray Painters (741.684-026) use spray guns to spray surfaces with finishes.

Stainers (742.684-014) use brushes, pads, or spray guns to stain parts of furniture, mirrors, or picture frames.

Airbrush Painters (741.684-018) use airbrushes to coat, decorate, glaze, retouch, or tint articles.

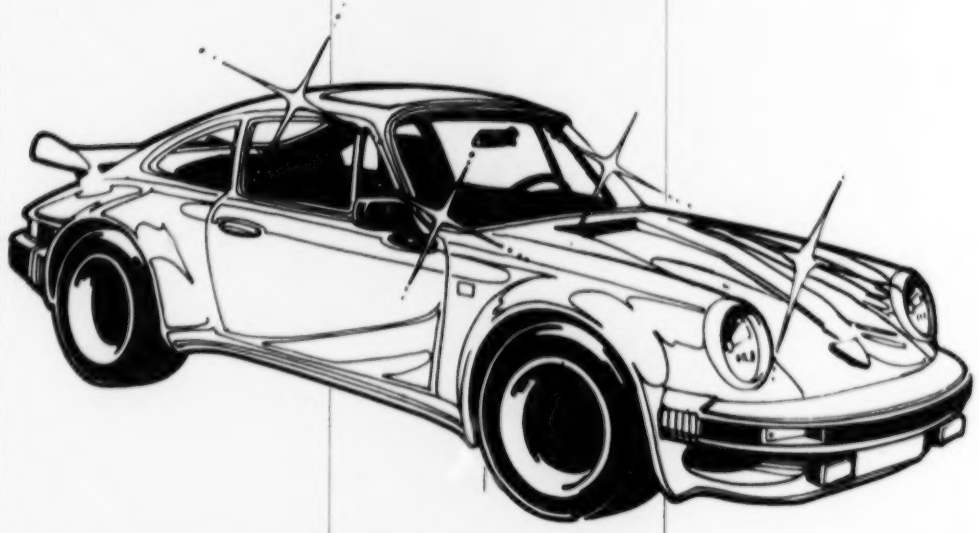
Rough Painters (741.687-018) spray materials, such as waterproofing, foam, or paint onto surfaces of articles where covering is required without the need for a finished appearance.

Working Conditions

Painters and coaters work indoors and may be exposed to dangerous fumes. The work is repetitive, and operators may have to stand for long periods. When using a spray gun, they may have to bend, stoop, or crouch to reach all parts of the article.

Painters and coaters work a 5-day, 40-hour week. Safety equipment such as protective clothing and masks that cover the nose and mouth are usually needed and supplied by the employer.

Painters and coaters may belong to unions, such as the International Union, United Automobile, Aerospace, and

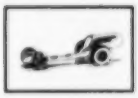


OCCUPATION SPECIALTIES

DOT CODE:
- 741.684-026 Painter, Spray
- 742.684-014 Stainer
- 741.684-018 Airbrush Painter
- 741.687-018 Painter, Rough

SOC CODE: 7756

OKLAHOMA CAREER SEARCH



PAINTING & COATING MACHINE OPERATOR

Agricultural Implement Workers (UAW), the United Furniture Workers of America, and the United Steelworkers of America.

Tools, Equipment and Materials used may include:
- Mixing Machines
- Compressors
- Spray Guns
- Paints
- Paint Shields
- Stains
- Electrostatic Painting Equipment
- Brushes
- Solvents
- Rust-Proofing Materials
- Sandpaper

Worker Requirements

You should like:
- Doing routine work
- Working with your hands
- Working with machines and equipment

You should be able to:
- Compare and see differences in the size, shape, and shading of objects

Physically you must:
- Have good vision, either naturally or with correction, and color vision
- Have full use of hands and arms
- Have good eye-hand coordination

Opportunities for Experience:

Ways to explore or gain experience in this field are through summer or part-time jobs with manufacturing firms.

Methods of Entry:

The most common method of entering this occupation is through direct application to employers. Assistance may be available through school placement offices, local unions, and by consulting newspaper want ads.

Earnings and Advancement

Earnings of painters and coaters depend on the employer, the extent of unionization, and the type of industry. Manufacturing painters may be paid an hourly or piecework rate. The earnings are highest in the eastern and midwestern states, and lowest in southern and northeastern states.

Earnings:

Full-time painting and coating machine operators earned median weekly salaries of $394 in 1990. The middle 50 percent earned between $265 and $456 a week, with the highest 10 percent earning more than $658 per week in 1990. Experienced automotive painters in large metropolitan areas earned $19.45 per hour on the average in 1990. Beginners start at about half the hourly rate of experienced workers and increase their wages as they progress.

Fringe Benefits:

Most painters and coaters receive paid vacations and holidays; life, accident, disability, and hospitalization insurance; retirement plans; and sick pay. These benefits are usually paid for, at least in part, by the employer.

Career Ladder for this Occupation may look like this:
- Supervisor
- Touch-Up Painter and Coater
- Paint and Coating Inspector
- Painting and Coating Machine Painter
- Trainee

As manufacturing painters gain experience, they may advance to more difficult and responsible jobs.

Employment and Outlook

There were approximately 159,000 production painters employed nationally in 1988. Employment in this occupation is expected to grow more slowly than the average for all occupations. Increased use of automatic painting processes and other labor-saving innovations will moderate demand for painters.

Related Education and Training

Level(s) of education and training usually needed for this occupation:
- On-the-job training
- High school diploma or G.E.D.

Level(s) of education and training also available for this occupation:
- Less than a high school diploma
- High school diploma with vocational education
- Apprenticeship

School subjects helpful in preparing for this occupation include:
- Auto Body Repair
- Metal Shop
- Auto Mechanics
- Shop Math

More Sources of Information

- Automotive Service Industry Association
  444 North Michigan Avenue
  Chicago, IL 60611

- National Institute for Automotive Service Excellence
  1920 Association Drive
  Suite 400
  Reston, VA 22091

- Automotive Service Association
  P. O. Box 929
  Bedford, TX 76021-0929

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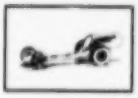


MECHANICAL ENGINEER

Nature of the Occupation

Mechanical engineers plan and design machines, tools, engines, and other equipment which produce or use power.

Duties may include but are not limited to the following:

- Designing products or systems
- Planning and directing engineering personnel in the fabrication of test control apparatus and equipment
- Developing methods and procedures for testing products or systems
- Directing and coordinating construction and installation activities
- Coordinating operation, maintenance, and repair activities to obtain the best use of machines and systems
- Evaluating field installations and recommending design changes to eliminate malfunctions

Occupation Specialties

(Dot codes in parenthesis)

Automotive Engineers (007.061-010) develop new or improved designs for automobile structural parts, engines, transmissions, suspension systems, and associated equipment. They may also direct the building, modification, and testing of vehicles.

Utilization Engineers (007.061-034) solve engineering problems concerned with industrial utilization of gas as a source of power.

Plant Engineers (007.167-014) direct and coordinate activities relating to the design, construction, and maintenance of equipment and machinery in an industrial plant.

Working Conditions

Mechanical engineers usually work with other engineers, managers, shop employees, construction workers, and drafters. They work at desks or drafting tables in well-lighted, climate-controlled offices. Mechanical engineers working in maintenance, production, construction, or installation activities generally work in plants or outdoors and are exposed to plant or weather conditions.

Mechanical engineers generally work a 5-day, 40-hour week. Overtime may be required in case of emergencies or to meet deadlines. Mechanical engineers working in production or maintenance may work on weekends and be on call at other times.

Mechanical engineers may join professional organizations such as the American Society of Mechanical Engineers and the National Society of Professional Engineers. Members usually pay dues.

Tools, Equipment and Materials used may include:

- Cars, Trucks & Buses
- Engines, Transmissions & Other Auto Equipment
- Instruments & Controls
- Transfer Systems
- Plans, Designs & Specifications
- Reference Books
- Calculators
- Computers
- Engineering Tools

Worker Requirements

You should like:

- Activities of a scientific and technical nature
- Activities involved with machines and mechanical devices
- Activities which require creativity

You should be able to:

- Work within precise limits or standards of accuracy
- Reason clearly and logically
- Perform arithmetical operations quickly and accurately
- Visualize flat drawings and pictures as solid objects
- Recognize detail in objects or drawings and slight differences in shapes and shadings
- Rate information by using personal judgment or measurable standards
- Plan, direct, and control activities

Physically you must:

- See well, either naturally or with correction
- Use your arms, hands, and fingers well

Special Requirements:

All fifty states and the District of Columbia have licensing regulations for engineers whose work affects life, health, or property. Each state administers its own examination. All states now have legal provisions to grant engineering licensing by reciprocity.

Not all engineers need to be licensed. The exceptions are engineers working: (1) for the Federal Government, (2) in a manufacturing or interstate commerce corporation, (3) in a public service corporation, and (4) as subordinates to registered engineers. However, the trend is toward licensing for everyone.

Opportunities for Experience

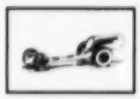
Opportunities for experience include summer and/or part-time work with manufacturing firms.

OCCUPATION SPECIALTIES

DOT CODE:
- 007.061-014 Mechanical Engineer
- 007.061-010 Automotive Engineer
- 007.061-034 Utilization Engineer
- 007.167-014 Plant Engineer

SOC CODE: 1635

OKLAHOMA CAREER SEARCH



MECHANICAL ENGINEER

Methods of Entry:

Methods of entering this occupation include direct application to employers and taking civil service exams. Positions may also be located by consulting newspaper want ads, college placement offices, and state employment offices.

Earnings and Advancement

Earnings depend upon the type, size, and location of the employer and the engineer's education, experience, capabilities, and job responsibilities.

Earnings:

Nationally, in 1990, mechanical engineers earned average salaries of $49,750. Mechanical engineers graduating with a bachelor's degree earned starting salaries of approximately $32,004 in 1990. Those with master's degrees earned an average yearly salary of about $37,605 and Ph.D.s earned an average salary of $50,645 annually. Mechanical engineers employed by the Federal Government earned a mean annual salary of $45,971.

Fringe Benefits:

Depending on the employer, mechanical engineers may receive paid vacations and holidays; sick leave; group health and life insurance; pension plans; and reimbursement for further education. These benefits are usually paid for, at least in part, by the employer.

Career Ladder for this Occupation may look like this:

- Senior Engineer/or Supervisor
- Mechanical Engineer
- Engineering Trainee

Engineers usually advance to positions of greater responsibility after gaining experience.

Employment and Outlook

There were approximately 225,000 mechanical engineers employed nationally in 1988. Employment of mechanical engineers is expected to increase about as fast as the average for all occupations through the year 2000 as the demand for machinery and machine tools grows and industrial machinery and processes become increasingly complex. Despite this expected employment growth, however, most job openings will result from the need to replace mechanical engineers who transfer to other occupations or leave the labor force for other reasons.

Mechanical engineers held about 2,207 in Oklahoma during 1986. That number is expected to increase to 2,571 by 1992, which represents a 16.55 percent change. Job openings each year for mechanical engineers will equal approximately 105, with 44 of those due to replacements and 61 created through new jobs.

Related Education and Training

Level(s) of education and training usually needed for this occupation:

- College bachelor's degree
- College master's degree

Level(s) of education and training also available for this occupation:

- College Ph.D. or professional degree

School subjects helpful in preparing for this occupation include:

- College Preparatory
- Algebra
- Computer Science
- Trigonometry
- Physical Science
- Humanities
- Drafting
- Machine Shop
- Metal Shop
- English
- Calculus
- Geometry
- Chemistry
- Physics
- Blueprint Reading
- Electricity & Electronics
- Mechanical Drawing

More Sources of Information

- American Society of Mechanical Engineers
  345 East 47th Street
  New York, NY 10017
- The American Academy of Mechanics
  c/o Civil Engineering Department
  Northwestern University
  Evanston, IL 60201
- National Society of Professional Engineers
  1420 King Street
  Alexandria, VA 22314
- Institute for the Advancement of Engineering
  P.O. Box 1305
  Woodland Hills, CA 91365
- College Placement Offices

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MATHEMATICIAN

Nature of the Occupation

Mathematicians deal with systems involving the relationship of quantities, magnitudes, and forms to conduct research and solve problems in other areas such as science and management.

Duties may include but are not limited to the following:

- Testing hypotheses and alternative theories.
- Conceiving and developing ideas for the application of mathematics to a wide variety of areas.
- Performing computations and applying methods of numerical analysis.
- Operating or directing the operation of mechanical and electronic equipment in support of mathematical, scientific, or industrial research.

Occupation Specialties

There are two types of professional mathematicians: those who work in pure or theoretical mathematics and those who work in applied mathematics. These two areas may overlap and are not always distinct in practice.

Working Conditions

Mathematicians often work closely with other professionals and specialists such as scientists, engineers, college staff members, computer scientists, or government officials. They usually work in quiet, comfortable offices, research laboratories, and classrooms.

Mathematicians usually work a regular 40-hour week. Evening and weekend work are common. Overtime may be required on special projects.

Mathematicians may join associations such as the American Mathematical Society, the Mathematical Association of America and the Society for Industrial and Applied Mathematicians. Members usually pay dues.

Tools, Equipment and Materials used may include:

- Computers
- Calculators
- Analyzers
- Plotters

Worker Requirements

You should like:

- Activities of a scientific and technical nature.
- Activities dealing with machines, processes, and techniques.
- Working creatively with numbers and abstract symbols.

You should be able to:

- Reason clearly and logically.
- Make judgments based on measurable data and experience.
- Visualize geometric forms and picture two-dimensional drawings as three-dimensional objects.
- Perform complex mathematical operations with accuracy.
- Understand the relationship between words and use them effectively.
- Direct and plan an activity or the activities of others.

Physically you must:

- Be able to reach for, handle, finger, and feel objects.

OCCUPATION SPECIALTIES
DOT CODE:
020.067-014 Mathematician
SOC CODE: 1739

OKLAHOMA CAREER SEARCH

MATHEMATICIAN

- See well, either naturally or with correction

Special Requirements:

A bachelor's degree is needed, and is considered adequate preparation for some jobs in private industry and government. An advanced degree is a prerequisite for the more responsible positions, and a Ph.D. is often required for research positions. A master's degree is the minimum requirement to teach in most 2-year and a few 4-year colleges, but the Ph.D. is necessary to attain full faculty status.

Opportunities for Experience:

Summer employment under the direction of mathematicians or participation in school mathematics or science clubs may provide useful experience.

Methods of Entry:

Methods of entering this occupation include direct application to employers, college placement offices, and civil service offices. Positions may also be located by consulting newspaper want ads, scientific and professional journals, and state employment offices.

Earnings and Advancement

Earnings depend upon the type of employer, nature of the work, and employee's education and experience.

Earnings:

The starting average salary in 1990 for mathematicians with a bachelor's degree was about $29,900; for those with a master's degree, about $32,200; and for those graduating with a Ph.D., about $44,200. Starting salaries were generally higher in industry than in government or educational institutions. The median annual salary of mathematicians with a doctoral degree was $52,800 in business and industry, $62,400 in educational institutions, $51,400 and in the Federal Government, $63,900. The average salary for all mathematicians working for the Federal Government was approximately $43,580 in 1990.

Fringe Benefits:

Depending on the employer, mathematicians may receive paid vacations and holidays; group life and hospitalization insurance; sick leave; and pensions. These benefits are usually paid for, at least in part, by the employer.

Career Ladder for this Occupation may look like this:

Mathematicians may advance into more responsible theoretical work or to management positions through experience and further education.

Employment and Outlook

There were approximately 49,000 mathematicians employed nationally in 1988, of which two-thirds held mathematics faculty positions in colleges and universities. Employment of mathematicians is expected to grow about as fast as the average for all occupations through the year 2000. Best opportunities are available for holders of doctorate degrees, especially in applied mathematics and computer science. Those with bachelor's or master's degrees in mathematics may have difficulty finding a job in university teaching or theoretical research. However, there will be many openings in applied areas such as computer science and data processing.

Mathematicians held about 120 jobs in Oklahoma during 1986. That number is expected to increase to 126 by 1992, which represents a 4.16 percent change. Job openings each year for mathematicians will equal approximately 1, with 0 of those due to replacements and 1 created through new jobs.

Related Education and Training

Level(s) of education and training usually needed for this occupation:

- College bachelor's degree
- College master's degree
- College Ph.D. or professional degree

School subjects helpful in preparing for this occupation include:

- College Preparatory
- Algebra
- Computer Science
- Statistics
- Chemistry
- Physics
- English
- Calculus
- Geometry
- Trigonometry
- General Science
- Economics

More Sources of Information

- American Mathematical Society
  Box 6248
  Providence, RI 02940

- Society for Industrial and Applied Mathematics
  1400 Architects Building
  117 South 17th Street
  Philadelphia, PA 19103

- Mathematical Association of America
  1529 18th Street, NW
  Washington, DC 20036

- National Council of Teachers of Mathematics
  1906 Association Drive
  Reston, VA 22091

- Association for Women in Mathematics
  Wellesley College
  Box 178
  Wellesley, MA 02181

TECHNOLOGY EDUCATION RESEARCH AND DESIGN

DAY 8 ACTIVITIES

POSTTEST

INSTRUCTIONS

You will need a computer scan sheet or card to record your answers to the following Posttest. Be sure to write your name, the title of the TLA, the date, and the class period on the computer scan sheet or card using a #2 pencil. Use rows 21-30 to record the answers to the Posttest. If your answers will be hand-scored, use a blank sheet of notebook paper to record your answers and number your answers 21-30.

SPELLING TEST INSTRUCTIONS

Use rows 31 - 40 on the test card. If the word is spelled correctly, mark (a) on the computer score sheet or card. If the word is spelled incorrectly, mark (b) on the test card. Be sure to use a #2 pencil and make your marks dark. If your answers will be hand-scored, use a blank sheet of notebook paper to record your answers and number your answers 31-40.

(a) correct (b) incorrect

Get Posttest Questions from your instructor.

When you finish the Posttest, return the test form and the computer scan card or notebook paper to your instructor.

If you complete Day 8 Activities with time left over, you may complete a Skunk Works Activity.

TECHNOLOGY EDUCATION RESEARCH AND DESIGN

SKUNK WORKS

BACKGROUND

The term *Skunk Works* comes from an engineering division of the 3M Company. In the late 1960s a group of engineers at 3M wanted to design a new product, but the managers of the company would not give them the money for research. So they decided to design the product anyway, then try to convince the company to market it. Whenever the engineers could grab a few extra minutes from their regular assignments, they worked on the new product. In early 1969 they presented it to the marketing division of 3M, and the company has been selling it ever since. The product: Velcro fasteners.

CHALLENGE

Your challenge in this Skunk Works is to design and construct a Windmobile, which is a vehicle powered by the exhaust of a heavy-duty vacuum cleaner. You should try to build a vehicle which goes farther than the others in your class.

You may only use the materials listed in the Tools and Materials section.

TECHNOLOGY EDUCATION RESEARCH AND DESIGN

SKUNK WORKS

TOOLS AND MATERIALS

- Safety glasses
- Lab apron
- 3 pieces of wood ¼" x ¼" x 36"
- Four plastic wheels
- 1 9" piece of ⅛" diameter axle rod
- 1 12" x 12" piece of mylar for the sail
- 1 soda straw
- Hot glue gun
- Glue stick
- Model cement
- Drill press

— Continued —

TECHNOLOGY EDUCATION RESEARCH AND DESIGN

SKUNK WORKS

TOOLS AND MATERIALS

- Jig saw
- Sander
- Assorted fasteners
- Pencil
- Heavy duty shop vacuum

OKLAHOMA TSA